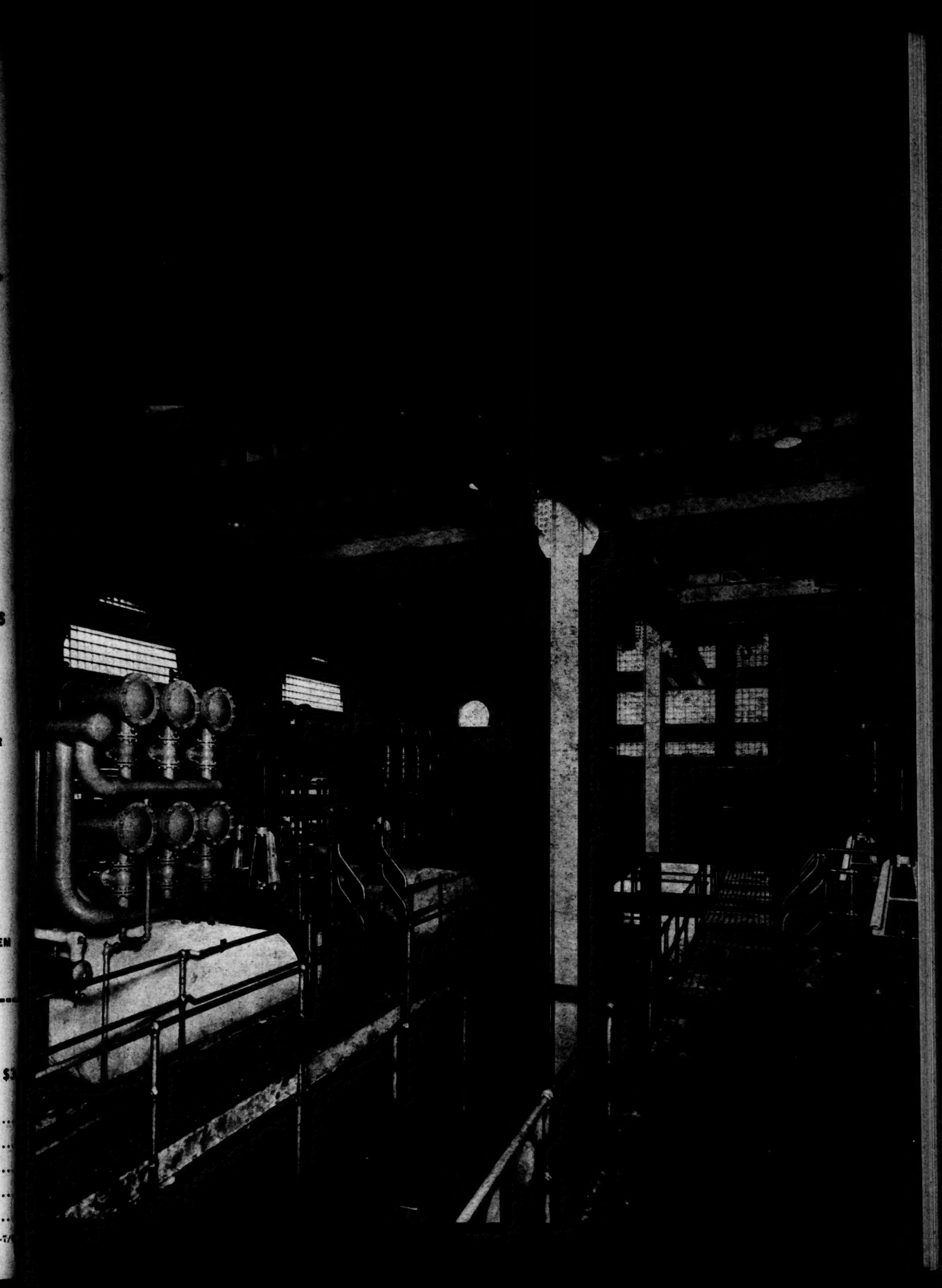

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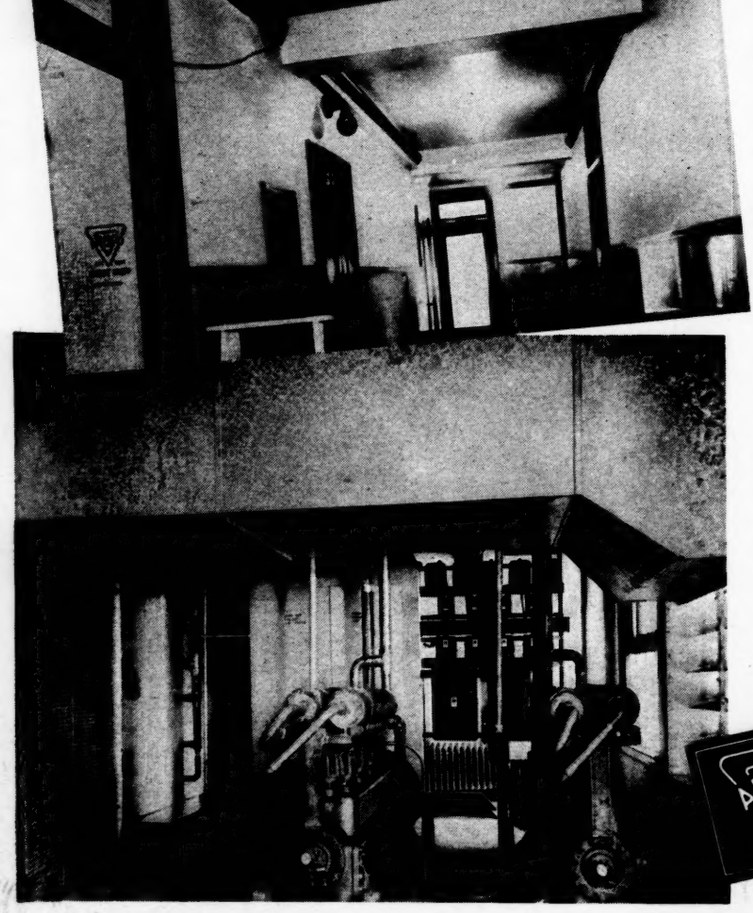

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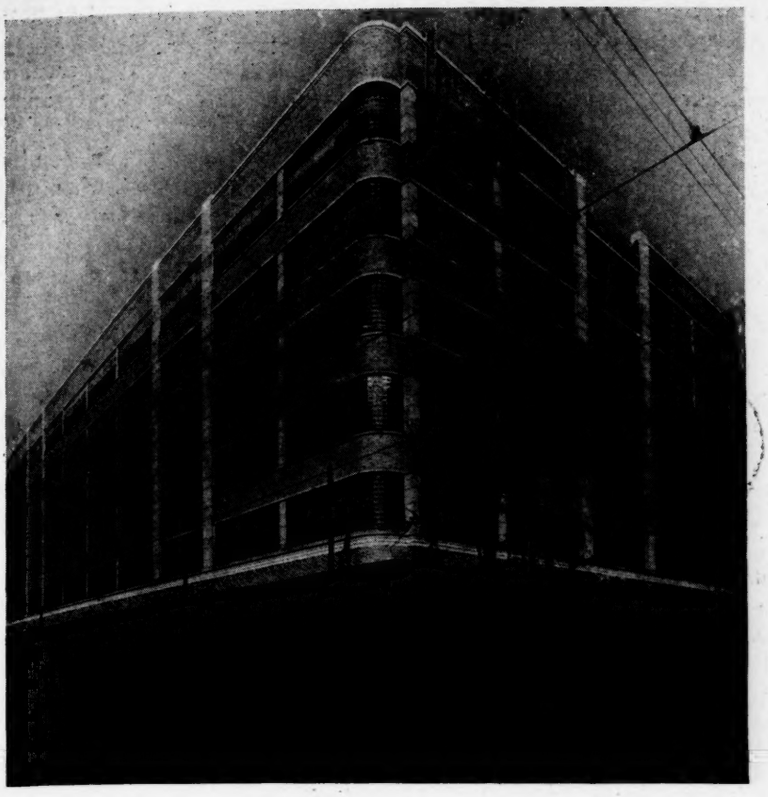


Fig. 1. Glass brick forms a translucent masonry wall in the new office and service building of Detroit Edison Company.

By J. H. WALKER†

With No Windows The Air Conditioning Must Be Good

THE use of glass brick completely replacing windows naturally calls for year-round air conditioning of the best possible type. Such was one of the problems confronting The Detroit Edison Company in the design of the building pictured in Fig. 1. It is a six-story building, covering an area of 248 ft. by 120 ft. and is to be used for offices and light shop work such as the repair of customers' electric appliances and the testing and repair of meters. Although the building has attracted public attention principally because of the extensive use of glass brick, actually the most important feature from the standpoint of economics of office building design is the air conditioning and the advantages which were taken of its possibilities.

Heretofore most buildings have been arranged with relatively narrow wings and with light courts in order to limit the distance from a window to any spot in the building. This practice is, of course, based on the assumption that proximity to a window is necessary for illumination and for ventilation. Office buildings, hotels and apartments have always been designed in this way. Department stores, however, have not and for obvious reasons. But with ample illumination and adequate air conditioning the necessity of the window, except to provide visibility to the outdoors, disappears.

Fig. 2 shows a plan of the building indicating the light courts which naturally would have been provided if the building had been designed in the conventional way. In fact, only a few years ago, the company did design (but did not build) an office building with approximately this same floor plan.

Having decided that year-round air conditioning would be highly desirable from the standpoint of the comfort and efficiency of the employes, full advantage was taken of its possibilities, together with the possibilities of a modern lighting system, and the floor plan adopted was the shape of a solid rectangle. Had the E-shaped floor plan been used a building of at least eight stories in height would have been required to provide an equal amount of usable floor space, and the estimated cost of such a building without air conditioning was nearly as great as that of the actual building including air conditioning. Although, at the present time, it would hardly be commercially practicable to design a rented office building in this manner, it seems perfectly sound to do so when the building is to be used exclusively by the owner. This important collateral advantage of air conditioning—in this case nearly sufficient to pay for itself—is probably not yet fully realized.

Problems with Use of Glass Brick

Glass brick is such a revolutionary material that it naturally introduces several design problems. It is the

†Engineer Assistant to the General Manager, The Detroit Edison Company.

equivalent of a translucent masonry wall and affects such things as heat gain and heat loss, illumination and fire fighting.

Further studies are required of its heat transmission under wintertime conditions. The coefficient used in the design was 0.50 B.t.u. per sq. ft. per hr. per degree difference in temperature. It so happened that the heat loss was not a critical factor in the design of the heating and air conditioning system inasmuch as the air quantities were fixed by the cooling requirements. Nevertheless, the writer feels that further work should be done on this subject.

Likewise the heat gain under exposure to sun radiation calls for further research. The figure used was that suggested by the manufacturer in the form of a percentage of the heat gain through unshaded factory type sash, and the latter was taken from work done at the ASHVE laboratory. It would have been feasible to have used awnings if ordinary windows had been adopted but was not believed feasible in conjunction with the glass brick. In fact, it was desired to avoid awnings, if possible, because of the annoyance and maintenance which they involve. The natural result was an increase in calculated heat gain which was, of course, reflected in the capacity of the air conditioning system.

The illumination characteristics of the glass brick are quite different from those of an ordinary window. The light transmission is considerably less than that of clear glass but the uniformity of illumination from the outside wall to the corridor wall is much greater. The aspect to the eye of the occupant is also different. Through a transparent window, one sees the bright sky when looking upward and the darker surrounding buildings when looking horizontally, or downward. The glass brick, however, averages out these variables and has a nearly uniform brightness when viewed from nearly any angle in the vertical plane. The problem of possible glare to the eyes of the occupants on the sunny sides in this building is still unsettled but it is probable that some form of shade will be required on the sunny sides.

It appears that the whole problem of illumination by daylight has been given insufficient attention when it is remembered that an office building is used largely during the daylight hours.

The increasing use of glass brick is attracting considerable attention from people interested in fire fighting. Questions such as the venting of the building in case of fire as is ordinarily done by breaking windows, and the escape of the occupants, are typical points. It seems unlikely that such matters will retard the use of glass brick since they do not seem of major importance to the owner or occupants.

Illumination

Employes working at points as much as 45 ft. distant from the exterior walls must, of necessity, have extremely good artificial illumination. In this case it was assumed that an illumination level of 35 foot-candles on the desk top was needed. The lighting system, as installed, gives 50 foot-candles when the lamps are new and the reflecting surfaces clean, thus allowing an ample margin for deterioration.

The lighting system used is rather novel in design, consisting of coffers about 4 ft. square and 15 in. deep recessed into the ceiling and using lamps with integral silvered bowls. The utilization efficiency of this method permitted the reduction in installed lamp wattage from 6.7 watts per sq. ft. of floor area, which would have been required with a conventional indirect lighting system, to 4.5 watts per sq. ft. and this is, of course, reflected in the refrigeration load.

Another important advantage of the coffer method

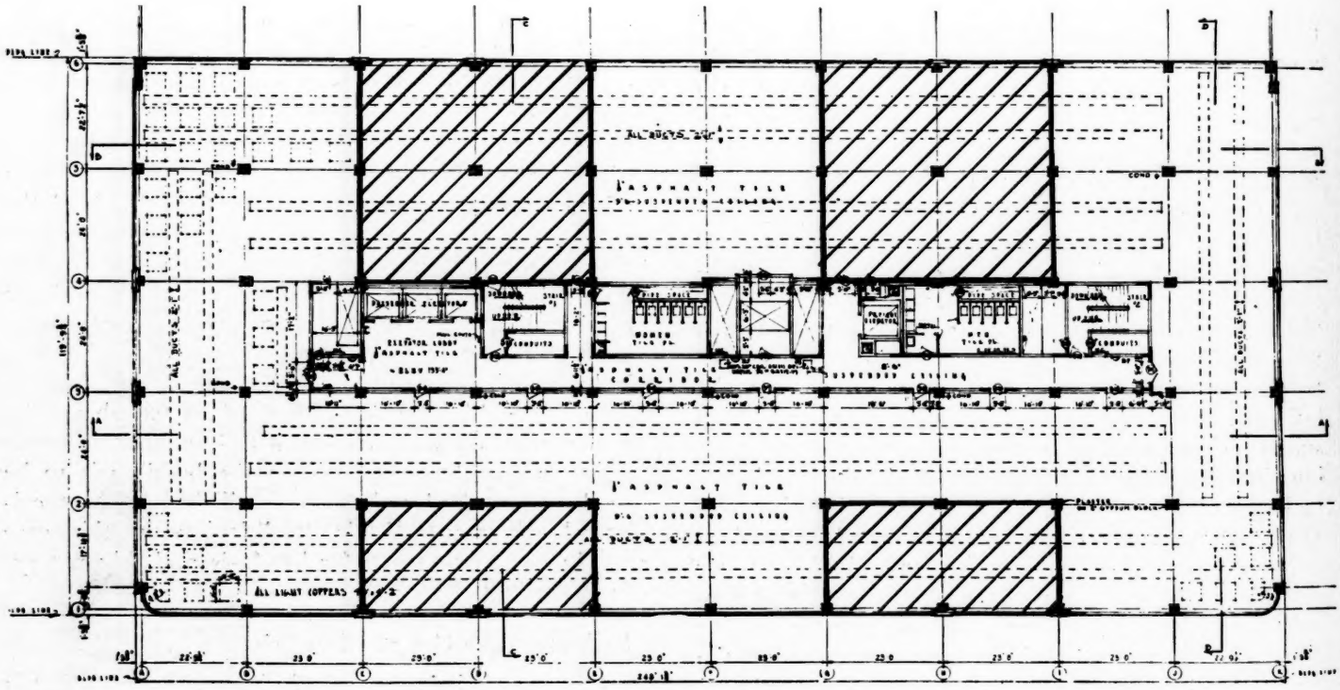


Fig. 2. The building cost was reduced by the elimination of light courts (shown cross-hatched).

lies in the possibilities of coordination with the duct-work of the air conditioning system. It was desired to avoid exposed air ducts and by installing them above the false ceiling and between the coffers it was possible to appreciably reduce the floor-to-floor height of the building with a definite saving in construction costs. The coffer lighting system also permits a lower ceiling height than is required for the ordinary indirect lighting fixture where high and uniform illumination is required.

By thus considering the air conditioning and the lighting as a combined problem, it was possible to effect a coordination which appears to have produced important economies without detracting from the performance of either.

Some thought was given to the possibilities of carrying away by a separate current of air some of the heat from the lamps but, attractive as this might seem at first thought, it does not appear to be practicable except in special cases. The arrangement of the coffer lighting system is evident in Fig. 3.

The Air Conditioning System

From the company's experience with air conditioning and from the experience of others, it was felt that the two major shortcomings which are most often encountered are (1) inadequate temperature control and, (2) excessive air velocities, commonly termed drafts. An attempt was therefore made to avoid these difficulties. With no windows which can be opened to remedy incorrect temperature control, this phase of the problem became doubly serious.

One of the controlling reasons for the selection of glass brick in place of windows was to avoid excessive heat loss and leakage which are characteristic of the latter. Double windows could, of course, have been used and would have avoided much of this difficulty, but would have involved maintenance and frequent cleaning. It was also desired to avoid, if possible, the use of direct radiators because of the discomfort caused to those forced to sit near them. With the decreased chilling effect of the outside wall through the use of glass brick it appeared feasible to eliminate any source of heat at the outside wall and to heat the building entirely by convection through the air conditioning system. The heating and cooling requirements are, therefore, supplied by the same system which circulates a uniform quantity of air both winter and summer, the temperature being varied in accordance with the heating and cooling requirements.

No attempt will be made in this article to describe fully the air conditioning system. A simplified diagram is shown, however, in Fig. 4. There are two sets of supply shafts, one carrying air at above the room temperature and the other carrying air at below the room temperature. These two supplies are mixed by a specially designed single-blade damper which varies the proportion of warm and cool air without affecting the total quantity. These dampers are controlled through thermostats operating with compressed air and the building is zoned to take into account the varying cooling load with the traverse of the sun around the building. The usual practices as to outside air introduction, control of indoor temperature in summer with respect to outdoor temperature, et cetera, have been followed.

The air is introduced to the room through strips in the ceiling between the coffers. The quantities of air required are relatively large because of the large sensible cooling load and extensive tests conducted prior to the final design indicated that this method of introducing the air from the ceiling over relatively large areas and at extremely low velocities gave promise of providing freedom from uncomfortable drafts, which could not be secured by any other method of introduction tested.

Air is withdrawn from the outdoor bays through a continuous slot below each panel of glass brick with the idea of catching the downward current of cold air along the face of the glass brick. Some air is also withdrawn through grilles near the floor in order to avoid the stagnation of cold air at the floor. From the inner bays air is withdrawn to the corridors through grilles in the doors and from the corridors it enters the vertical return shafts, through which it flows to the fans and coils located in the basement.

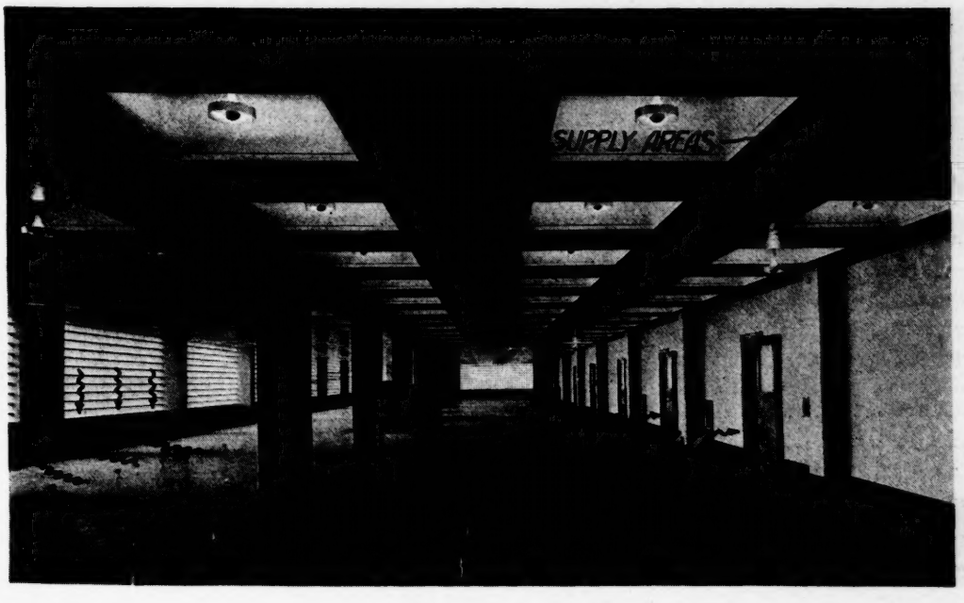
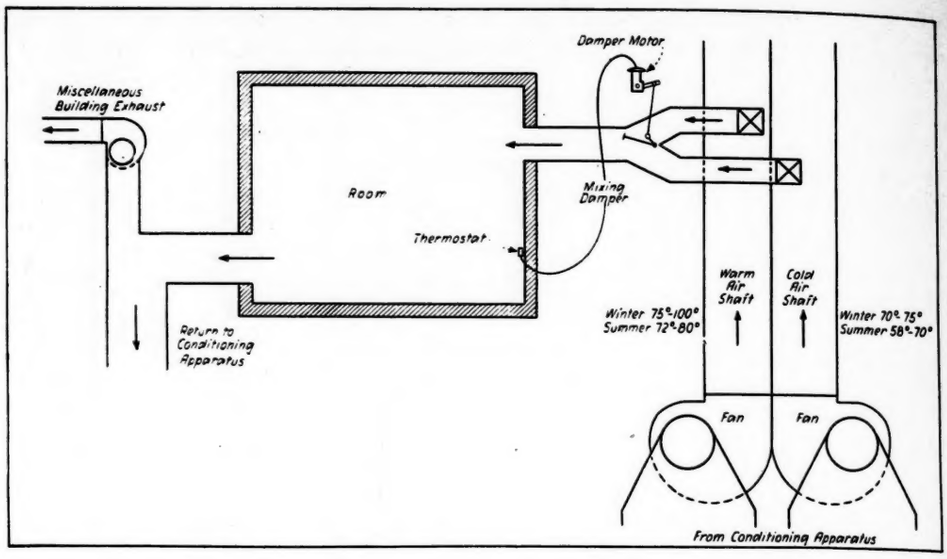


Fig. 3. Air enters through the perforated metal ceiling and leaves both under the glass sidewalls and through corridor vents.

Fig. 4. Both heating and cooling are done by means of the fan system.



Provision is made to use 100% outdoor air at such times as its temperature is suitable. Under this condition the question of static pressure in the building becomes important. It would be undesirable to have an appreciable negative or positive pressure which would cause annoying drafts at the entrances. The fact that the building is so nearly air-tight permits the building-up of substantial pressures. To avoid this, an automatic static pressure control is provided.

Although some of the special features of this building were a result of the peculiar conditions of ownership and occupancy, nevertheless, it seems to illustrate the possibilities of air conditioning in its effect upon building design.

Method of Designating Air Conditioning Systems

A SUGGESTED method of designing air conditioning systems was incorporated in a paper presented by W. B. Hughes before the University of Illinois Short Course in Coal Utilization recently. Abstracts of his paper follow:

The air conditioning industry has almost reached the point where types of systems have become stabilized, and these we can discuss. The eight phases, or functions (ventilation, air cleansing, air circulation, noise elimination, heating, humidification, cooling, dehumidification), can be accomplished by means of any one of three distinctly different systems: (1) the split system; (2) the indirect system; (3) the direct-fired system.

The first, or split system, is not generally understood, most frequently being considered as a system in which part of the heating is done with air and part with radiators. The technical definition of a split system as given by the ASHVE is as follows: "system in which the heating and ventilation are accomplished by means of radiators or convectors, supplemented by mechanical circulation of air (heated or unheated) from a central point." This type of system is frequently called a radiator conditioning system, an auxiliary system, or some similar name.

Solely for our purpose here, in order that we may get a clear understanding of the operation of the split system, let us call the system in which part of the heating is done by air and part by radiators or convectors a divided system and discuss it from that angle. Thus, we now have four distinct types of systems: (1) the split system; (2) the divided system; (3) the indirect system; (4) the direct-fired system.

First, we will discuss them from the standpoint of winter air conditioning.

In the true split system all heating is done by radiators or convectors placed in the different rooms. Air cleansing, ventilation, air circulation and humidification are accomplished by a separate unit operating independently or in conjunction with the heating system.

With the divided system part of the building is heated with radiators or convectors and part with warm air distributed through ducts and registers.

In the indirect type of system steam or hot water is usually the medium by which heat is transferred from the boiler to the heating units located adjacent to the boiler. The air passes over the heating units and is conveyed to the spaces to be heated or conditioned through a system of ducts.

The direct-fired system utilizes the heating principle of the warm air furnace. The air passes directly over the hot castings of the furnace and by forced circulation is conveyed through a system of ducts to the spaces to be heated or conditioned.

The features of temperature, humidity, air cleansing, air motion and distribution may be incorporated in all these systems.

If summer cooling is required, cooling and dehumidification equipment may be installed and used in conjunction with any of these four types of air conditioning systems.

The Outlook for Building Improves

By L. SETH SCHNITMAN†

BUILDING resisted the recent forces of depression better than any of our other basic industries. And this is a wholesome portent both as respects the industry itself and as regards business generally; especially is this true now that clouds elsewhere in the economic skies are lifting. Still another reason for optimism is found in the June, 1938, figures on contemplated building operations, reported by the F. W. Dodge Corporation. These showed a volume of newly-planned building in the 37 eastern states, exclusive of heavy engineering, amounting to a little more than $650,000,000, almost trebling the June, 1937, contemplated building total of $236,000,000.

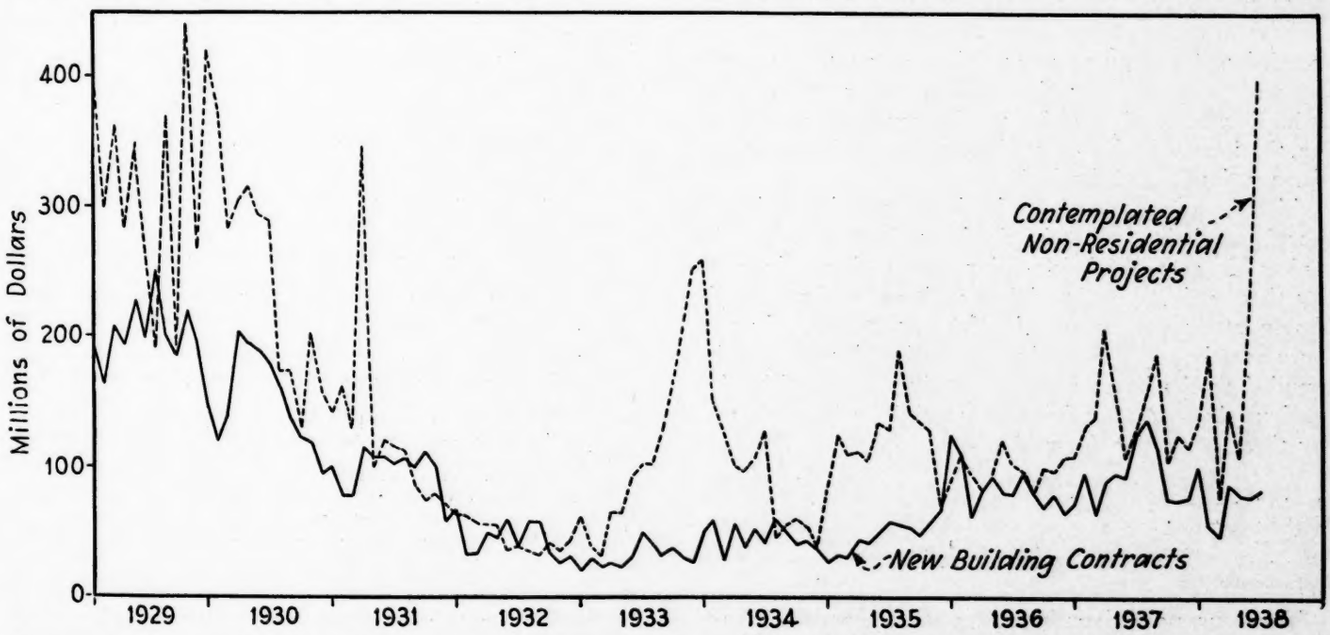
True, this large gain in newly-planned building projects has its genesis in the spending-lending program of the Federal government. Yet if no more than 60% of the planned work is executed, the present level of contemplated building and its likely maintenance at relatively high levels over the nearby months afford reasonable assurance that the final half of 1938 will turn in a construction performance that will not only exceed the figures for the initial half of 1938 but those for the final half of 1937 as well.

During the first half of 1938 building projects started or contracted for in the 37 eastern states involved an estimated expenditure of $833,000,000. During the corresponding period of 1937 the total was $1,081,000,000, while in the final half of 1937 the volume of building operations undertaken in the same area totaled $974,000,000. Let us dissect these figures a bit.

For residential building the 1938 half-year total in the states east of the Rocky Mountains amounted to $399,000,000. This represented a decline of about 23% from the figure of $517,000,000 for the initial half of 1937. For non-residential building the half-year total in 1938 amounted to about $434,000,000, likewise representing a shrinkage of about 23% from the corresponding total for the first half of 1937 of $565,000,000. Though the relative losses from 1937 were about equal as between residential and non-residential building, it is significant to note that as to residential building, purely private operations performed better than did public housing, while in the case of non-residential building private types suffered the greater retrenchment. More specifically it was not surprising, in the light of sharp losses in commercial and industrial activity, to witness declines in commercial and factory building from the levels of a year earlier of 30% and 63% respectively. Nor was it surprising that residential building, privately undertaken, was able to limit its loss better than the private type of non-residential building, in the light of the more liberal terms of credit under the FHA system, which became effective early in 1938.

As to non-residential public and semi-public projects, the back-log of building under earlier Federal and local authorizations was sufficient to offset measurably the drastic declines which were occurring in commercial and factory building operations. In the case of residential building, the sluggishness of the public housing program authorized in August, 1937, militated against a better performance for the housing field as a whole.

†Consulting Economist, New York.



Contemplated non-residential building projects compared with new non-residential contracts, covering 37 eastern states (F. W. Dodge Corp. data). The peaks in contemplated work in 1933 and 1935 resulted from preliminary proposals of numerous projects intended primarily as work producers, many of which never materialized. It is believed, however, that the greater part of the 1938 peak is made up of sound proposals. In addition it is believed that the lag between contemplated projects and contracts, earlier in evidence, will be somewhat shortened by urgent pressures for restimulating employment in the heavy industries.

This then brings us to a consideration of prospects. How do they shape up? Now that public construction is again in the forefront as an implement of synthetic business recovery, reflection of which has already been noted in the figures on contemplated building, it is reasonably safe to conclude that we are nearing the point where public non-residential building types will much more than offset present depressed conditions in the commercial and factory building classifications. What is more, if the stimulus of pump-priming takes hold, which it may likely do, even commercial and factory building may be expected to be undertaken in somewhat larger volume than is presently the case. But it is well to remember that customarily commercial and factory building lags behind industrial recovery by at least a year, which should mean that no appreciable betterment in these building categories should be looked for until some time next year, although alterations and modernization should continue apace.

For residential building as a whole, favored now as it has been since early this year by easy terms of finance, the outlook is substantially improved, especially since ground has been finally broken on the first of the new public housing projects of the United States Housing Authority with additional USHA housing projects soon to follow. In this connection the recently-effected agreement between USHA and more than 50 building trades unions, assuring non-stoppage of work on public housing projects, may well prove as a pattern for cooperation between labor and builders on purely private housing of large-scale dimensions. This agreement provides that building labor will be given wage payments prevailing at the beginning of the job throughout the life of the operations, in return for which the labor unions have agreed not to stop work because of jurisdictional disputes or demands for higher wages while a given job is in progress.

Apropos of this agreement and its interesting possibilities particularly as to large-scale housing operations by private initiative all eyes are now turned to the new Metropolitan Life Insurance Company's housing project, presently to rise in New York City. More than being the largest single housing project ever to be undertaken, this development may point the way the country over to a new and plentiful source of private money to enter the housing field on a pure investment basis.

All in all, high building costs notwithstanding, more liberal credit terms to home-builders, an enlarged public housing program, a rejuvenated pump-priming philosophy, and an improving tendency in business and industry generally are operating to provide satisfactory assurance that the nearby months should bring in greater volumes of building activity, both residential and non-residential, both private and public than we witnessed earlier in the year.

Heat Emission of Animals and Fowls

DATA on the amount of heat given off by human beings at various degrees of activity are well known and are fairly well established and of sufficient accuracy for air conditioning calculations. However, similar data for animals likely to be inhabitants of air conditioned structures at one time or another are not so well known. For that reason the accompanying table is presented in order to give approximate figures on the heat emission of various types of domestic and farm animals and fowls.

The heat output, given in B.t.u. per hour, is the basal metabolism; that is, the heat given off when the animal is at rest. Information on the heat given off by these animals under different degrees of activity is fragmentary and scattered. In the absence of more accurate data the following correction factors can be applied to the basal figures to arrive at quantities for various degrees of activity (multiply the basal figures by these correction factors):

Degree of Activity	Multiplying Factor
Awake but at rest	1.0
Moderately active	1.5
Brisk motion	2.5
Slow run	6.0
Extreme exertion	10.0

The figures are given in ranges and the smaller figure represents the figure for small animals of that particular type while the larger figure applies to the largest animal in that classification since, in general, the heat emission varies with the weight within a given classification of animals.

	Heat Output, B.t.u. per Hr. At Rest
Sheep	
Adult rams	288— 416
Adult ewes	200— 240
Swine	
6 mo. pigs	288— 346
Mature boar	725—1045
Mature sow	590— 890
Cattle	
Ayrshire cows	955—1120
Ayrshire bulls	1320—1660
Guernsey cows	955—1120
Holstein cows	1045—1445
Holstein bulls	1740—2180
Jersey cows	794—1045
Jersey bulls	1580—1660
Horses	
Draft horses	1580—1910
Saddle horses	955—1120
Mules	
Farm mules	955—1260
Mining mules	725—1320
Chickens	
Adult cocks	23— 44
Adult hens	17— 34
Turkeys	
Adult cock	83— 86
Adult hen	52— 58
Geese	
Adult gander	39— 68
Adult goose	34— 58
Ducks	
Adult drake	19— 34
Adult duck	17— 29
Dogs	
Very large	112— 224
Large	67— 112
Medium size	20— 67
Very small	5— 20
Cats	
Large	26— 46
Small	6— 26

How the Alternating Receiver Works on Vapor Systems

By T. NAPIER ADLAM†

The various vapor systems of steam heating are in wide use in both large and small buildings. One of their distinctive features is the method of returning the condensed steam to the boiler through an alternating receiver. The principles of this device and its proper location and functioning are all too frequently misunderstood even by people who work with them regularly. This article was prepared as a result of direct requests by readers for an explanation of this device.

TO understand fully the function of an alternating receiver or boiler return trap it is necessary to study its application and its relation to other equipment allied to it. Since an alternating receiver is used principally on vapor heating systems, it is advisable to review the subject of Vapor Heating to understand the function of the alternating receiver.

Vapor heating systems are built and are commercially available in considerable variety. These systems differ from each other largely in the detail designs of the fittings, accessories, and specialties used in connection with them. They are also commonly known by a variety of names such as vapor-vacuum, vacuo-vapor, atmospheric, and others. However, they all resemble each other closely in operating principles. Figs. 1, 2, and 3 illustrate some of the variations in trapping and in the arrangement of the piping mains but these three illustrations by no means present all the possible "system" arrangements.

The use of the phrase "vapor heating system" usually implies a two-pipe system of heating by vapor or very low pressure steam (say at ½ lb. to 1 lb. or even at sub-atmospheric pressures) in which the condensate flows by gravity to a device called an alternating receiver or boiler return trap. This piece of equipment discharges the condensate into the steam boiler against the pressure within the boiler, while any air discharged from the pipes and radiators finds its way out through another device known as an air eliminator. These devices are typical of vapor systems and it will be noted in Figs. 1, 2, and 3 that there is an air eliminator and an alternating receiver shown in each figure in spite of the differing detailed arrangement of piping and traps.

Supply Main

It is also typical of vapor systems that the steam main is graded to fall in the direction of steam flow, in order that both the condensate and the steam can flow in the same direction, thus eliminating any possible risk of "steam hammer."

With the main so graded it is necessary to arrange for draining condensate at the extreme end and also to arrange for air in the main being properly disposed of. For example, in Fig. 2 a float-thermostatic trap is used. Similarly in this same illustration a float-thermostatic trap is used at the bottom of each supply riser, a practice which is common especially if the riser supplies three or more floors. Figs. 1 and 3 use other methods at the end of the mains although it will be seen that the main slopes with the steam flow in all these illustrations.

Return Main

In considering the typical arrangement of return piping it is well to keep in mind that a wet return is installed below the water line in the boiler and is always full of water, while a dry return is installed above the water line of the boiler so that it is only partially filled with water, allowing air to pass freely with the water.

Both wet and dry returns slope toward the boiler in order to provide a gravity gradient for the return condensate. With small systems, or where there is very little headroom, a wet return line is often used to carry the condensate from steam mains directly back to the boiler instead of draining with a steam trap. Since this wet return will be subjected to the full steam pressure in the boiler, it must not be connected to the alternating receiver. The wet return is shown at "L" in Fig. 1 where a check valve is shown inserted at "M" to prevent water being forced from the boiler back up the wet return pipe should the pressure in the boiler be much higher than the pressure at the end of the steam main, as often occurs when starting up with heavy firing.

Where the steam pipes are drained into the wet return without the use of steam traps, as shown in Fig. 1, the water will rise in the vertical pipe "P" until the height of the water level in the pipe above the water line in the boiler is equal to the pressure in the boiler. This condition limits the maximum permissible pressure in the boiler to the total height "V." Should the steam pressure in the boiler rise above this amount the water will back up in the pipe and flood the steam main. This would cause noise and would air-lock part of the system. When steam traps are used for draining the steam mains and risers with the discharge going into a wet return, the wet return should be taken into the alternating receiver as shown in Fig. 2. This arrangement prevents trouble due to high boiler pressure. If the steam mains are sufficiently high, the drain from mains and risers may be taken back overhead as shown in Fig. 3, thereby eliminating the need of a wet return.

The dry return pipe is graded towards the alternating receiver in order that the condensate from the system may be carried along by gravity in the same direction as the air, and the air eliminator should be installed at the end of the dry return so that it may collect all air as it reaches the drop pipe "E."

†Chief Engineer, Sarco Co., Inc.

Radiator Arrangements

At the steam inlet to each radiator of Figs. 1, 2, and 3 a packless inlet valve is shown to control the flow of steam or vapor to the radiator, while a thermostatic trap is placed at the discharge outlet of each radiator to prevent steam from entering the return pipes. To ensure best results under sub-atmospheric operation a bellows type packless radiator valve is popular to insure that contact surfaces remain air tight. The radiator traps should operate with a reasonable temperature differential, but at the same time should be capable of permitting air and condensate to escape from the radiator into the return pipe. With this arrangement as outlined it is not necessary or advisable to provide air valves on the radiators as all air should be discharged through the eliminator which, if desired, can be made capable of holding a good vacuum and thus permit the system to work at sub-atmospheric pressures.

Arrangement at the Boiler

Since the air eliminator and alternating receiver are so essential a part of the vapor system, the arrangements made to secure their proper functioning are essential. To permit a detailed examination of how they are attached to the boiler piping of Figs. 1, 2, and 3, a sketch is presented in greatly enlarged scale as Fig. 4.

Air Eliminator

Details of the air eliminator are shown in Figs. 5, 6, and 7. The type shown in Fig. 5 is suitable for small systems, say up to 2000 or 3000 sq. ft. of heating surface, and the larger type shown in Fig. 6 for larger systems.

The function of this device is to eliminate all air and other non-condensible gases from the system by venting them to the atmosphere with a float device provided to prevent water escaping. The eliminators illustrated also have an aluminum check valve to prevent the ingress of air back into the system although all eliminators do not include this feature. The eliminator should be installed at the top of the dry return pipe preferably at the junction where it drops to the boiler, as shown in Figs. 1, 2, and 3.

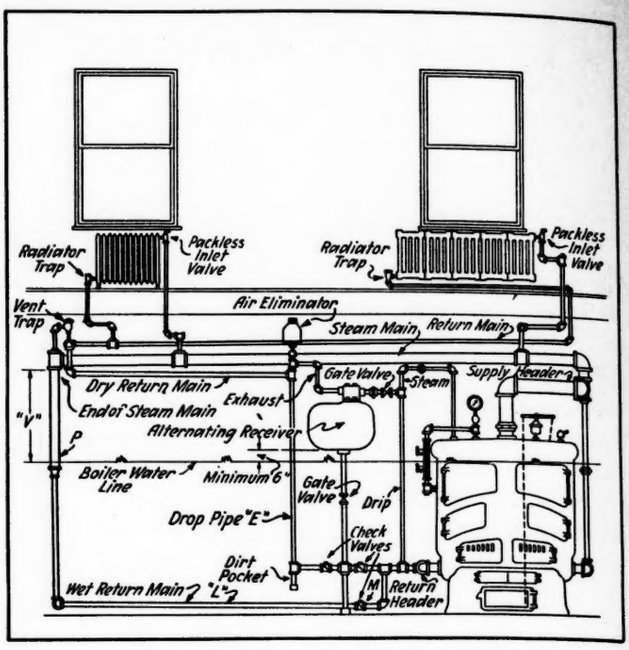


Fig. 1. Typical vapor heating system.

As regards the details of the air eliminator it is essential that the valve "A" (Figs. 5 and 6) resting on the top of the outlet "B" form a tight check so that air cannot be drawn back into the system when the pressure drops below atmospheric. A valve head "C" screwed directly into the copper float as shown in Fig. 5 or connected to a lever mechanism as shown at "D" in Fig. 6 is used to prevent the discharge of water should an accumulation of water build up in the dry return pipe. Therefore, with either of these designs it is possible for air to pass freely out at the valve "B", while it is impossible for air to re-enter or for water to escape from the system.

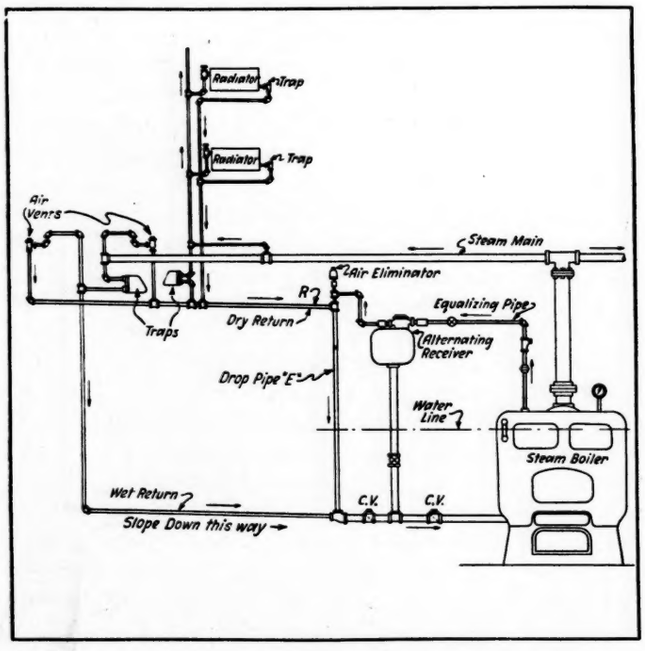


Fig. 2. Vapor system trapped to permit draining of steam main into wet return.

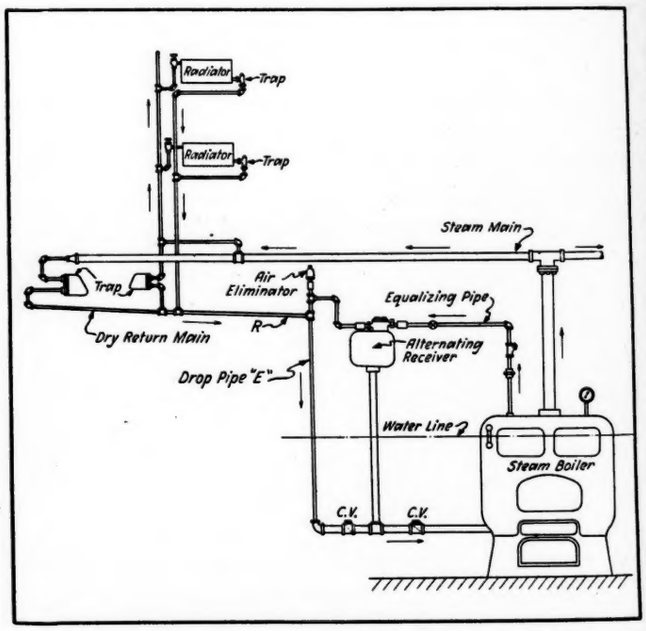


Fig. 3. Vapor system trapped to permit draining of steam main into dry return.

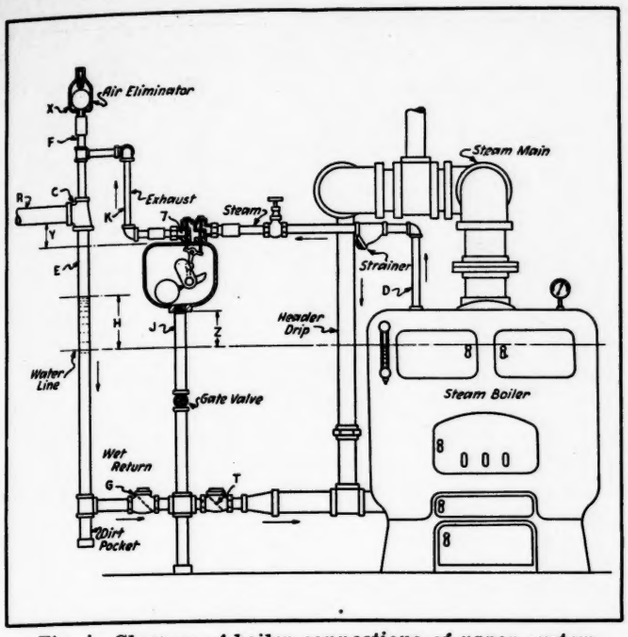


Fig. 4. Close-up of boiler connections of vapor system.

The valve "A" should be made light in weight and sufficiently large to vent the system quickly, especially when an oil burner is installed. An oil burner will generate steam more rapidly than an ordinary coal or coke fire and will build up a pressure of air in the system unless it can escape freely through the eliminator. The air eliminator should have sufficient margin of power on the float to open the valve "C" against the highest steam pressure put on the system, otherwise water may rise in the body of the eliminator and close it. Then the excess air pressure will keep it closed so that air cannot escape.

With any vapor or steam system where a steam trap is installed on each radiator, coil, and riser, no steam should find its way into the dry return pipe, so that no steam should reach the air eliminator. Hence there is no need under such circumstances to fit the eliminator with a thermostatic element.

Should a steam trap leak from any cause, it should be attended to immediately, and the air eliminator is often the first place where evidence of a leaky trap will be found, as any escaping steam will find its way out of the valve "C." As soon as steam is noticed at the air eliminator an investigation should be made to find the faulty trap and have it corrected. Steam at the eliminator, when starting up a new job, would also indicate that an element may have been omitted from a steam trap, or what may be more likely, a cross-over connection inadvertently made between steam and return pipes. If the steam pressure on the system is above 4 to 5 lb. there may be some vapor given off by re-evaporation from the condensate, especially if there is a large number of float traps used on mains or unit heaters.

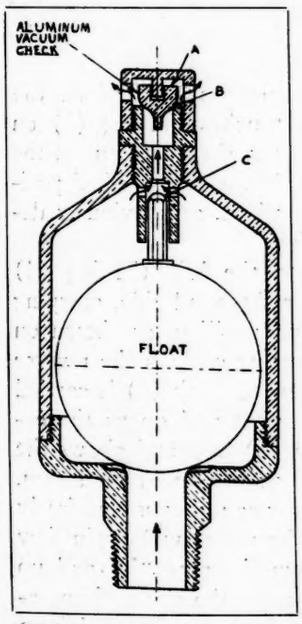
Should an air eliminator with a thermostatic element as shown in Fig. 7 be installed instead of the free open type, it would be possible for steam to pass one leaky trap or a cross-over connection and on reaching the eliminator cause the thermostatic element to expand and close the air valve, thus sealing up any air left in the system. This would make the whole system ineffective without giving any outward evidence as to the cause of the trouble. Therefore a thermostatic air relief should never be installed on the return of any of these systems where steam traps are employed for draining all the coils and radiators.

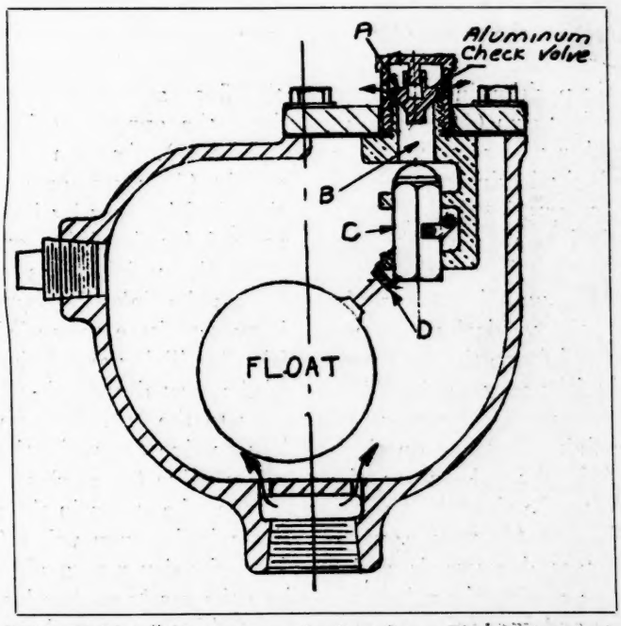
Alternating Receiver

One design of an *Alternating Receiver* or *Boiler Return Trap* is illustrated in Figs. 8a and 8b. Essentially this is a cast iron receiver fitted with a copper float which operates steam and exhaust valves as the level of the water in the body rises and falls during each operating cycle.

The piping details showing how this receiver and the air eliminator are connected to the return line of a vapor system are illustrated in Fig. 4 and the cycles of operation are as follows:

Air and condensate from the heating system flow





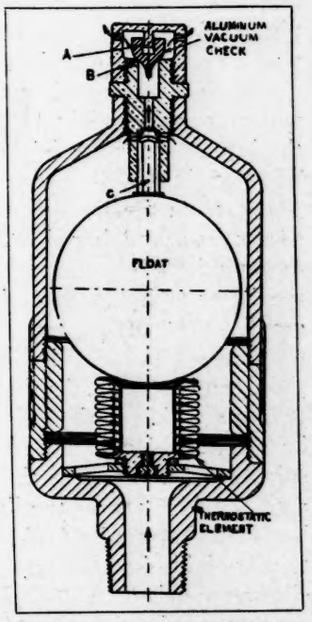


Fig. 5. (left) Air eliminator with ball float and vacuum check valve. Fig. 6. (center) Air eliminator with swing float. Fig. 7. (right) Air eliminator with ball float and thermostatic element.

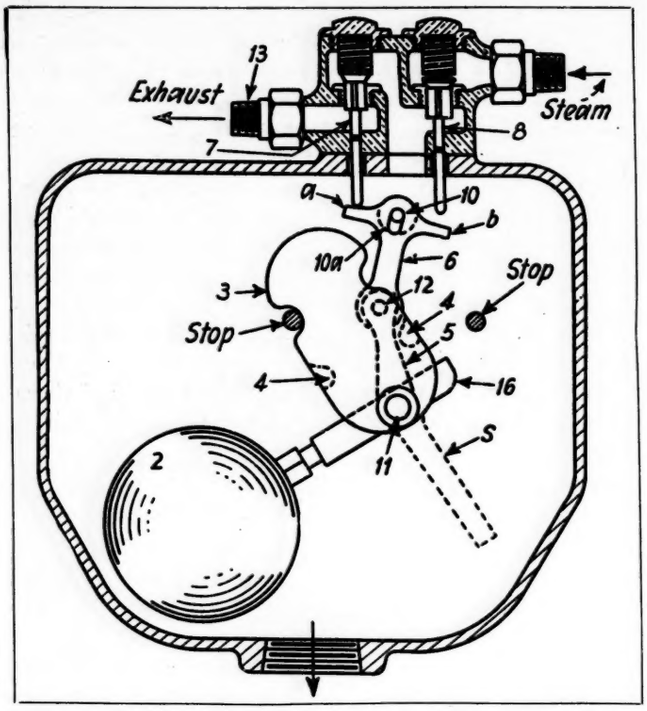


Fig. 8a. Alternating receiver at end of discharge period.

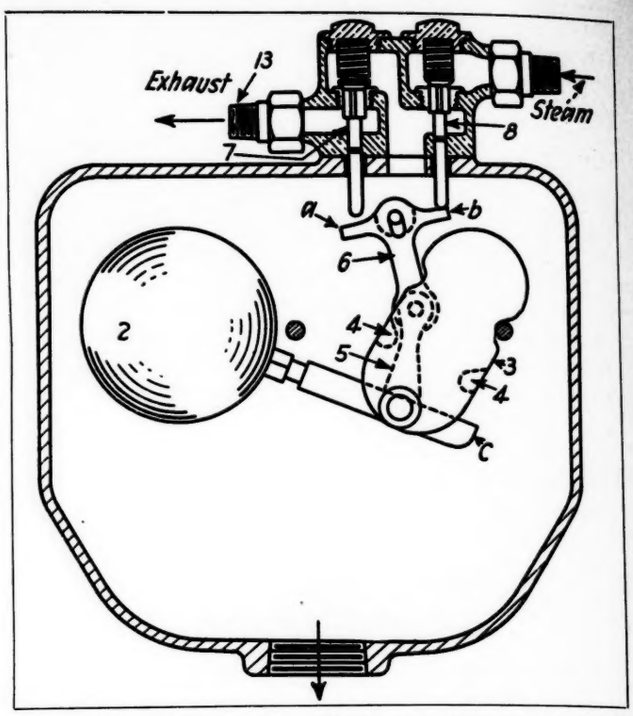


Fig. 8b. Alternating receiver at beginning of discharge period.

along the dry return pipe "R" to the point "C" where the condensate drops down the vertical pipe "E," while the air rises upward in the pipe "F" and is discharged through the valve of the air eliminator. As long as no pressure exists in the boiler, the condensate will normally flow from the dry return pipe directly into the boiler by passing through the two check valves "G" and "T," respectively. When, however, the steam pressure in the boiler rises above atmospheric, the water in the pipe "E" will be held up to a height "H" which will be equal to the static pressure in the boiler.

As soon as the pressure in the steam boiler is sufficiently high to prevent the water in "E" flowing directly into the boiler, it will rise higher in the pipe "E" until it is above the level of the alternating receiver, and will then flow through the check valve "G" up the pipe "J" and into the receiver. As the level of the water rises in the body of the receiver, the float (2) Fig. 8a, also rises and at a certain position in its travel will engage the weight (3) as the float arm (16) touches the lug (4) of the weight (3) and carries same with it. The weight (3) is a cast iron body having two lugs, (4), cast on the same face but on opposite sides of the center line, and bored and bushed to move freely on the spindle (11). As the float moves the weight (3), the latter turns on the spindle (11) until its center of gravity axis passes just beyond the vertical position, when it will fall over by its own weight to the extreme right hand position. As the weight falls over, the lug (4) strikes the side of the link (5), carrying it also over to its right hand position. As the link (5) turns on the spindle (11), it carries the pin (12) through an arc of a circle which moves the link (6) to the right, by turning it on the spindle (10). As the link (6) moves over to the right, its left arm (a) drops downwards and allows the exhaust valve (7) to fall, closing the exhaust outlet, while its right arm (b) lifts and opens the steam inlet valve (8).

At this stage of the cycle, the receiver is nearly filled with water, and the float (2) is in its highest position, as shown in Fig. 8b. As the steam valve (8) is now open, steam is allowed to pass from the boiler through the open valve (8) by way of the equalizing pipe "D," Fig. 4.

As the steam pressure above the water in the receiver is now equal to that in the boiler, the water will flow by gravity out of the receiver down the pipe "J" through the check valve "T" (Fig. 4) and into the boiler.

The check valve "G" prevents any flow back of water into the pipe "E" when the valve (8) is open, admitting steam to the receiver and forcing water into the boiler.

As the water flows out of the alternating receiver into the boiler and the level of the water recedes, the float (2) gradually falls and when near the bottom, the float arm extension (c) engages the weight (3) from the opposite side as it touches the lug (4) on weight (3). As soon as the center of gravity line of the weight (4) passes over to the left of the vertical position, it falls over by its own weight, as previously described for the filling operation.

As the weight falls over to the left, the lug (4) strikes the link (5) from the right hand side, carrying it over to its extreme left hand position, as shown on Fig. 8a. This part of the operating cycle is the reverse of that just described, so that as the link (6) is carried over to the left, the arm (a) rises and opens the exhaust valve (7) while the arm (b) falls and allows the steam valve (8) to close, tightly shutting off the steam.

Since the steam in the receiver can now escape freely through the open valve (7), the water will again flow from the dry return pipe, down the pipe "E" and up into the receiver, thereby repeating the cycle of operations. The very small amount of steam exhausted from the receiver through the valve (7) as it throws over,

passes along the pipe "K" into the air vent pipe, where it is easily condensed and the water of condensation returns back into the system, thus preventing waste of water.

Exhaust Outlet

It is very essential in installing the alternating receiver illustrated to connect the exhaust outlet (13) (of Fig. 8a) to the vertical air vent pipe "F" (Fig. 4) below the air eliminator, so as to ensure a free vent and a good vacuum when the pressure in the boiler drops to below atmospheric. On no account must the exhaust pipe be connected to the bottom of the dry return pipe, and all joints in pipe "K" (Fig. 4) and its connections should be made perfectly air-tight.

Receiver Capacity

The capacity of an alternating receiver is very important, because unless the maximum rate of condensation can be dealt with, the system will become water logged, and the boiler will lose its water. The amount of condensate to be dealt with may be calculated by allowing 1 lb. of water for every square foot of equivalent direct radiator, plus the condensation from mains, risers, and runouts. Since, however, the initial condensation when starting up from cold will be much greater than the steady load, a sufficient margin must be allowed to deal with the peak load plus any excess water due to priming. Usually it is safe to allow 25% for mains and 50% for heating up, but in any case an alternating receiver should always be at least capable of dealing with the maximum steaming capacity of the boiler with a margin to deal with priming.

The rate at which any size alternating receiver will operate depends on several factors, all of which are important, and since the time of operation can be divided into two parts, we can consider the filling and discharging operations separately.

Filling Rate

By reference to Fig. 4 it will be seen that the rate at which the condensate will flow into the receiver will depend on (a) the height "Y" of the water level in the pipe "E" above the highest level of the water in the receiver, (b) the size of the pipes "E" and "J," (c) the power necessary to lift the check valve "G" and (d) how soon the steam left in the receiver body can escape through the exhaust valve (7).

Thus it can be seen, the higher the dry return pipe "R" can be installed above the top of the receiver, the faster will the receiver fill. It is also important to select a check valve "G" with a light gate, requiring only a small head to move it from its seat.

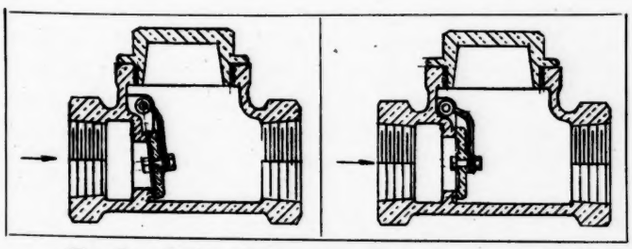


Fig. 9a. (left) Check valve with inclined gate.
Fig. 9b. (right) Check valve with vertical gate.

Discharging Rate

The rate at which the condensate will flow into the boiler will depend on: (a) the distance "Z" between the lowest water level in the receiver above the water level in the boiler; (b) the power necessary to lift the check valve "T" and, (c) how soon the equalization of the steam pressure in the receiver to that in the boiler takes place.

Thus it can be seen, the higher the alternating receiver is installed above the water line in the boiler the greater will be its capacity.

It is usually considered good practice to install the receiver with a minimum height of 6 in. from the bottom of receiver to the water line in the boiler, but much better results will be obtained if this height can be increased to 12 in. or even more. The higher the boiler pressure the more necessary it is to have the alternating receiver installed as high as possible above the water line in the boiler.

Since it is also important to have the dry return pipe well above the receiver, the distances "Y" and "Z" may be considered as of equal importance.

The size of the valve (8) Fig. 8a, and the size of the equalizing pipe "D" are of great importance, because it is necessary to equalize the steam pressures as quickly as possible after the receiver is full.

One important point is to see that the pipe "D" is connected directly to the steam boiler as close as possible to the water gage fittings. Since, when a boiler is steaming very hard, it is possible to have a 4 to 6 oz. differential pressure from the boiler to the steam main and a differential pressure between the boiler and receiver of only 2 oz. will make a difference of nearly 4 in. in the water level, it is very important not to connect the pipe "D" to the steam main. Two or three ounces differential pressure in the alternating receiver will hold the water up in the receiver and prevent its working, if the receiver is not installed sufficiently high above the water level in the boiler.

Check Valves

The gate of the check valves "G" and "T" (Fig. 4) should be suspended with an angle not more than 10° or 15° from the vertical and providing the gate makes a tight valve. It is an advantage to have the angle made even less than 10°. Some suitable types have the gate suspended vertically with the point of suspension behind the gate face, so that the center of gravity keeps the gate on its seat (see Figs. 9a and 9b).

If the check valve "G" leaks, the water will be allowed to pass freely back into the pipe "E" when the receiver discharges instead of being forced into the boiler.

If the check valve "T" leaks, the water from the boiler will flow back into the receiver while it is filling. Either of these faults can be generally detected because either will set up a rapid cycle of receiver operation without filling the boiler.

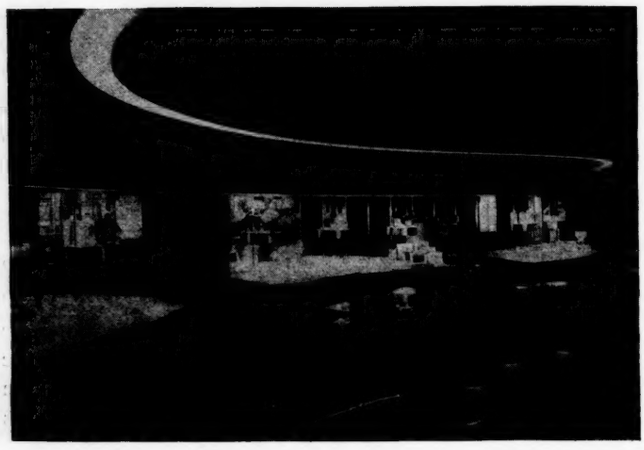
If the discharge cycle is too rapid, it indicates a leaky valve at "G," whereas if the filling cycle is too rapid, it indicates a leaky valve at "T". In the event of trouble with a leaky check valve, both should be examined and made perfectly free to move with tight shut-off.

How to Reduce Heat

During the past few years the intensity of lighting installed in commercial buildings has steadily increased. This has, in turn, increased the heat load which must be removed by the air conditioning equipment and has caused air conditioning engineers to pay more attention to methods of reducing these loads. This article presents information on the various methods of lighting and tells how the heat from lights may be decreased. It is based on data obtained from Walter Sturrock's paper entitled "Effects of Artificial Lighting on Air Conditioning" which was recently presented before the ASHVE.

AIR conditioning engineers are beginning to feel the effects of the electric industry's "Better Light—Better Sight" campaign for increased lighting in stores, offices, and homes. As a result the public is demanding levels of illumination double and triple those used 10 to 15 years ago. That the levels called for can be expected to continue to rise in the future can be seen when it is realized that interior lighting intensities are still far below the thousands of footcandles found out-of-doors.

This increasing lighting load has a great effect on the heat load of summer conditioning systems. Each watt-hour of energy consumed by electric lights releases 3.415 B.t.u. in the form of heat—a large percentage of which must be removed by the cooling equipment.



The relative importance of the lighting load compared with the other loads for a number of typical buildings can be seen from Table 1. This table was prepared from calculated values made while designing cooling systems. It should be noted that these represent the percentage of heat load due to lights when the system is operating at maximum design conditions. On cooler days, since the lighting load remains constant, the percentage will be much greater.

It can be seen from Table 1 that lighting is responsible for a part of the cooling load varying between 5 and 50% of the load, depending on the type of the building. Thus anything which can be done to help reduce this load will lower considerably the load on the system and the operating costs.

Energy Given Off by Incandescent Lamps

A gas filled incandescent lamp of the 300 to 500 watt size when operated at normal voltage in still air will have an energy distribution about as shown in Table 2. Hence from a clear gas filled lamp about 90% of the energy is in radiant form and the rest will be dissipated by the filament supports and glass.

The radiant energy of a bare lamp will not be effective in raising the temperature of a room until it has been intercepted by an absorbing surface which in turn will dissipate the heat by convection. The radiant energy will, however, increase the feeling of warmth to the human body by its radiant effect. Practically all surfaces such as building materials, room furnishings, and lighting equipment absorb a part of the wave energy reaching them from a burning lamp. As far as the lighting equipment is concerned the amount of radiant energy intercepted by it will depend upon its type.

One of the most generally used types of lighting equipment is the white glass enclosing globe. If a lamp is placed in one of these units it is estimated that on the average the globe will absorb something of the order of 15 to 25% of the 81% radiant energy reaching it from the lamp filament and nearly all of the 8% reaching it from the bulb. Hence, when the lamp bulb is placed in a white glass enclosing globe there will be 60

Loads from Electric Lights

to 65% of the energy dissipated in radiant form. The remaining 35 to 40% of the energy is dissipated from the lamp and enclosing globe by conduction and convection. Theoretically, it is only this heat that can be removed from the lighting units by a circulating air system and some attention has been given to this possibility in order to reduce the heating effect.

Heat Load Due to Lights

When the air conditioning engineer calculates the heat load due to lighting as the watts times 3.415 he is applying a fairly good safety factor. First not all of the radiant heat goes to heat the room because some of it will pass through the windows and will be dissipated out of doors and some of that striking the floors and walls is absorbed by the building structure and partially dissipated during the cooler night hours. Then too the hot glass warms the surrounding air which rises and forms a stratum of very warm air near the ceiling. If this is not disturbed it will not affect the comfort of the occupants especially if the room has a high ceiling.

It is difficult to estimate the exact amount of heat which will become a part of the cooling load. Estimators place it at from 50 to 90% of the watts consumed or 1.7 to 3.1 B.t.u. per watt-hour.

Methods of Reducing Lighting Load

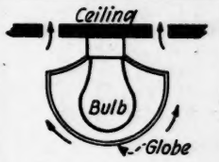
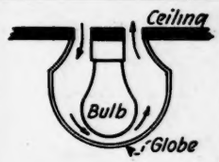
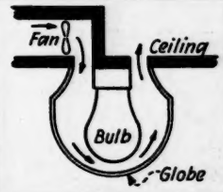
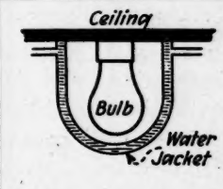
One of the best ways of reducing the lighting load is to increase the effectiveness of the lighting system, that is, to so plan the lighting system that the light is utilized more effectively and therefore less wattage is required to maintain the necessary illumination level. The utilization of light depends not only upon the ability of the side walls and ceiling to redirect the light but also on the total light output of the reflector or diffusing globe in which the lamp is placed.

A conventional lighting system in an ordinary office has about a 24% utilization of light. In a recent office installation this was increased to 32% by the use of small indirect aluminum reflectors which directed the light towards a special ceiling also of aluminum. In other words, to get an equal level of illumination from a conventional system about 33% more current would have to be used with a resulting higher heat load. Another installation in a public utility building showed a utilization of 42% against the utilization with a conventional system of 28%. In this case the conventional system would have required 50% more current.

With the adoption of higher levels of illumination, particularly in smaller rooms, the color of the vertical surfaces in the line of vision has become a very important psychological factor. From this point of view the cooler colors in side wall finishes are desirable. In selecting these colors, it is not necessary to choose a side wall finish of extremely low reflection factor, which would not only be depressing but would also create an undesirable contrast. In general, side wall finishes having a reflector factor of 45 to 55% are quite satisfactory. Colors such as the light greens, light blues and various mixtures of them come within this range. They have been satisfactorily used in many interiors where 30 or more footcandles of illumination were installed.

Removing Heat from Lights

It is possible to take advantage of the tendency of the heat to rise by enclosing the bulbs in glass globes which open into a false ceiling. The warmed air can then be removed by circulating outside air through the ceiling. One series of tests showed that approximately 30% of the heat from the bulbs could be removed in this manner. The actual amount of heat from the bulbs

METHOD OF COOLING BULB		HEAT REACHING ROOM, Percent
	EXHAUST AIR OVER BARE BULB	90
	EXHAUST AIR OVER ENCLOSING GLOBE	70
	GLOBE OPENING TO FALSE CEILING	70
	FORCED VENTILATION THROUGH GLOBE	67
	BULB ABOVE CEILING OF HEAT ABSORBING GLASS	28*
	WATER COOLED BULB	28*

* TAKES INTO ACCOUNT REDUCED EFFICIENCY DUE TO LIGHT ABSORBED

TABLE 1.—RELATIVE IMPORTANCE OF LIGHTING LOADS IN VARIOUS INSTALLATIONS

Type of Installation	Heat Load of Lights, Per Cent of Total Load
Electrical Sales Office	50
Office Building	
With awnings	37
Without awnings	26
Glass block walls	31
Cafeteria	9
Theater	5

TABLE 2.—ENERGY DISTRIBUTION FROM AN INCANDESCENT LAMP

Type of Energy	Per Cent
Visible Radiation	11
Invisible Radiation	70
Heat Conducted Through Filament Supports and Leads.	3
Heat Convected and Conducted by Gas	8
Heat Radiated by Bulb	8

which was removed could not be determined because the heat passing through the false ceiling tended to raise the air temperature in the false ceiling.

More accurate tests made with air circulated between the glass globe and the bulb showed that 33% of the heat from the bulbs could be removed. In this case the glass globe was suspended in air held at a constant temperature. This amount, 33%, is close to the maximum amount of conducted and convected heat available, as mentioned previously.

Heat Absorbing Materials

When the light from an incandescent bulb passes through water a large percentage of the heat radiation is absorbed. For example when the light from a 1500 watt projection lamp passes through a water jacket, through which cold water is circulating, approximately 75% of the radiant energy is absorbed while the light output is reduced only 20%. It would be possible when this type of bulb is employed to reduce the heat load of the lighting as much as 72% even when taking into account the increased wattage necessary to overcome the light absorbed by the water.

Another substance for absorbing the radiant energy of lights is a heat-resisting, heat-absorbing glass having a 2-millimeter thickness which will absorb 79% of the total energy generated from a 500 watt projection lamp. The light transmission of this special glass is still maintained fairly high, being approximately 75%. Plates of this glass are available for use in false ceilings above which artificial lighting systems can be installed. With such a system a circulation of air could be produced to cool the glass plates and thereby provide a method of eliminating a high percentage of the radiant energy from a lighting system before that energy is set free in an interior.

When this type of system is employed a maximum of 72% of the lighting load may be eliminated even when taking into account the increased wattage required to overcome light absorbed by the glass.

Where Heat Removal Should be Used

Careful consideration should be given to all installations where the lighting load is more than 5 watts per sq. ft. of floor area. It is on these jobs that the relatively expensive exhaust systems will pay for themselves in the reduced operating and initial costs of the cooling equipment.

On jobs using less than 5 watts per sq. ft. it will generally be cheaper to provide the additional cooling capacity rather than use an exhaust system.

Why Not Use the American Standard for Steel Pipe?

PIPE manufacturers and consumers are all being penalized by not promoting the use of the American Tenative Standard for Wrought-Iron and Wrought-Steel Pipe, according to an article by Sabin Crocker in "Industrial Standardization." If pipe for all purposes including ordinary applications were ordered according to the schedules of pipe thicknesses outlined in this standard, the greater ease in design and specification and decreased material cost would benefit all interests.

The primary purpose of this American Standard is to reduce the large number of odd weights of pipe to a few standard commercial schedules of thickness, and thus to simplify the stocking problem so that any of the schedule thicknesses can be secured from jobber's stocks. This aim has not yet been realized, however, due to the unwillingness of the piping trade to abandon the obsolete terminology of "standard weight" and "extra strong" as such, although most of these thicknesses actually are included in the new schedules.

The standard sets up rational schedules of thickness with reference to a constant ratio of fluid pressure to bursting stress throughout the entire size range. This makes it feasible to select from the same schedule, wall thicknesses for all pipe diameters for any one pressure service—main steam piping, for instance. This is a decided simplification from former practice. It was formerly necessary to select from several weights of pipe in order to obtain reasonable uniform working stresses throughout the range of diameters needed. Better conformity is assured between plant conditions and pipe wall thickness as contained in the schedule thicknesses of the new standard.

Lighter wall schedules than the old "standard weight" have been provided for economy in welded construction where the pipe is not weakened by threading. Rapidly increasing erection of pipe in the field by welding has enabled selection of thinner wall pipe than was formerly available in "standard weight." More of the lighter weight pipe would be called for now if it were available from jobber's stock. At the present time, it is impossible to secure these thicknesses from local jobbers with the result that Schedule 40 is often ordered when a lighter weight pipe would serve to better advantage.

Installation Methods for Securing Subcooling with Evaporative Condensers

By RICHARD E. HOLMES†

IT is necessary to have a solid liquid stream after any condenser in a refrigeration system. A solid stream means a flow of refrigerant which consists entirely of liquid and in which there are no gas bubbles. The problem of obtaining subcooling with an evaporative condenser so as to provide a solid stream is an interesting one, and will be discussed at some length here. When refrigerant leaves a liquid receiver, it may be 100% liquid, but after passing through a length of tubing and suffering a drop in pressure, the liquid may begin to boil and form gas bubbles. This will happen unless the liquid has been subcooled in the receiver a sufficient number of degrees below the saturation or boiling temperature to counteract the drop in pressure which the liquid suffers in flowing through the tube. If the liquid is subcooled 10F to 15F below the saturation temperature (assuming the use of F-12, or dichlorodifluoromethane), it can stand a reduction in pressure of about 15 to 20 lb. per sq. in. without beginning to boil and form gas bubbles. Dichlorodifluoromethane which is the refrigerant most commonly used in air conditioning today, is so heavy that the liquid cannot be made to flow vertically upward a very great distance even when it has been previously subcooled a reasonable amount without suffering a sufficient reduction in pressure as to cause boiling. If the refrigerant was subcooled before entering the vertical pipe, it is not necessary that it arrive at the expansion valve in a 100% liquid state. *A mixture of gas and liquid at the expansion valve is not in itself wasteful of refrigeration as long as the liquid stream was solid at some point after the condenser.* Whenever *uncondensed* gas passes all the way through a condenser, through the liquid receiver and the liquid line, and into the expansion valve, there is a waste of refrigeration. It is a waste of electrical energy to pump uncondensed gas around the refrigerant system. Thus, if the liquid is subcooled sufficiently so that there is a solid stream at some point in the system after the condenser, then the only objections to the unavoidable presence of gas mixed with the liquid at an expansion valve which is considerably higher than the liquid receiver are, (1) the necessity for a larger expansion valve orifice to pass

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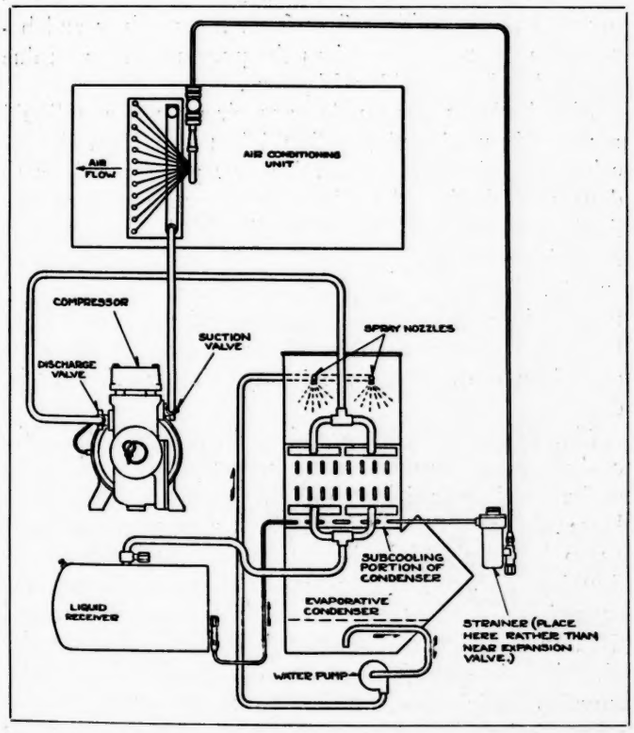


Fig. 1. (Above) Refrigerant circuit when liquid is taken from receiver and circulated through condenser to obtain subcooling.

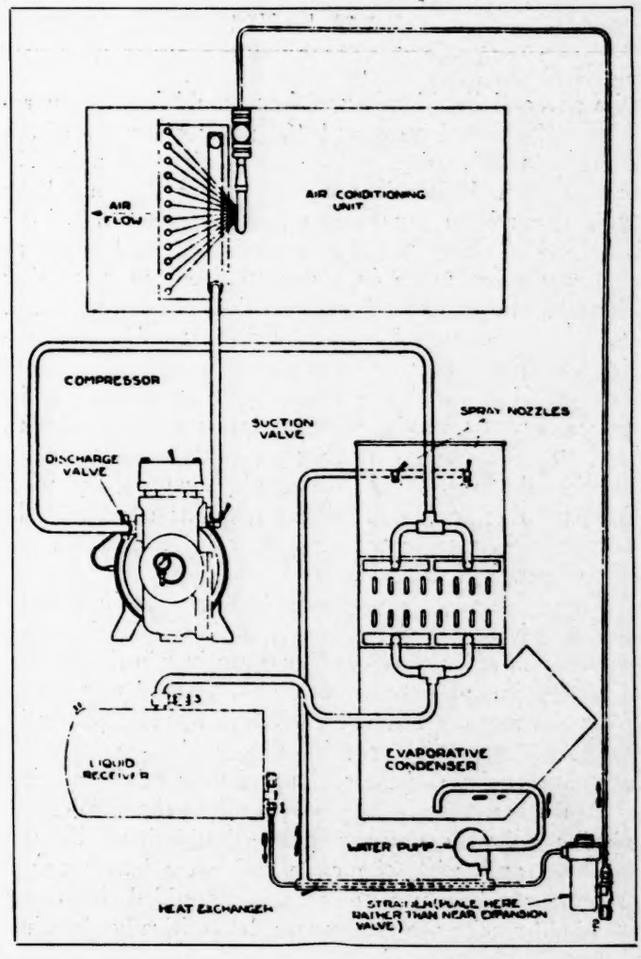
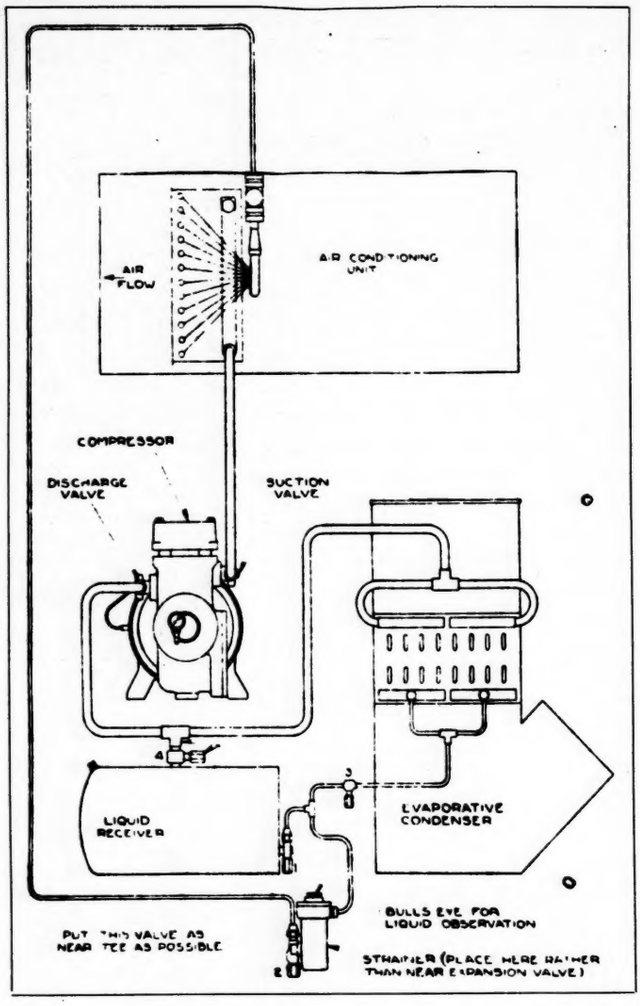


Fig. 2. (Right) Circuit employing a water cooled heat exchanger for subcooling.



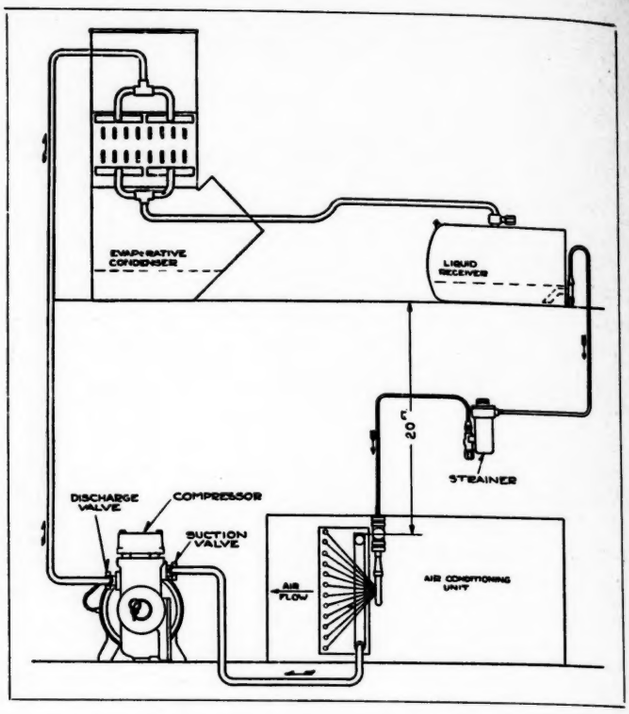


Fig. 3. (Left) Connection for obtaining subcooling without use of heat exchanger.

Fig. 4. (Above) Method similar to Fig. 3 except that refrigerant passes through the receiver.

the gas and liquid mixture than would have been required for liquid only, and (2) noisy operation of the expansion valve due to the gas passing through. No refrigeration is lost just because gas and liquid both pass through an expansion valve because some of the liquid in any case would have to be changed to gas at the expansion valve in order to cool the remaining liquid to the evaporating or cooling coil temperature. Subcooling does, of course, represent additional refrigeration capacity and it is advisable to have it wherever possible. In the case where 10F subcooling is obtained, but the vertical rise of pipe is great enough to use up this amount of subcooling and also to cause considerable gas to form, the additional refrigeration capacity due to the subcooling remains effective. No reduction in total cooling capacity is suffered due to the presence of this gas.

Four methods are in current use for obtaining subcooling of the liquid refrigerant with evaporative condensers: first, by placing a liquid receiver in the system after the condenser, and running the liquid refrigerant from the receiver back through several more passes in the condenser coil for subcooling and thence to the expansion valve and the cooling coil; second, by placing a liquid receiver in the system after the condenser, placing a heat exchanger in the liquid line after the receiver, and using the evaporative condenser spray water for subcooling the refrigerant; third, by using no liquid receiver in the system, but critically charging the refrigerant circuit so that some liquid refrigerant is backed up into the last few passes of the condenser coil; and fourth, in special cases where the condenser is located a considerable distance *above* the cooling coil, simply using a liquid receiver in the system, and allowing saturated liquid to flow from the receiver and become, in effect, subcooled as the pressure increases due to the head of liquid refrigerant.

Fig. 1 shows the refrigerant circuit when a liquid receiver is used and the liquid is taken from the receiver and circulated through a few passes of the condenser to obtain subcooling. In this arrangement, the liquid receiver may be charged with several pounds excessive refrigerant which is held there as a reserve supply. Such a circuit is practical and workable but usually increases the cost of the condenser coil and of the installation because of the additional headers required on the coil and the extra piping which must be done.

Fig. 2 shows the connection diagram for the subcooling system in which the receiver is used and a heat exchanger is placed in the liquid line after the receiver. Here the spray water from the evaporator condenser sump is circulated in heat transfer relation with the liquid refrigerant. The water is pumped through the space between the two tubes of the heat exchanger and the liquid refrigerant is allowed to flow in the opposite direction through the inner tube. The heat exchanger supplies sufficient subcooling to allow several pounds pressure drop in the liquid line ahead of the expansion valve. This arrangement also allows an excessive charge of refrigerant to be placed in the receiver as a reserve.

In Fig. 3 is shown the connection scheme for ob-

taining subcooling without the use of a heat exchanger or a liquid receiver. This is the cheapest arrangement because it requires the least equipment. A liquid receiver is usually supplied, however, but it simply serves the purpose of a storage tank when it is necessary to remove the refrigerant from the system to work on some piece of equipment. It is necessary to charge this system critically, that is, to place just enough refrigerant in the system to back up the liquid refrigerant in the last pass or two of the condenser coil. The cooling effect of the last pass or two serves to subcool the liquid and to provide a solid liquid stream at the expansion valve, if there is not too great a pressure drop in the liquid pipe line.

A fourth arrangement for piping evaporative condensers into the refrigerant system of an air conditioning installation is suitable only when the evaporative condenser is at least 20 ft. above the expansion valve and evaporative coil. When the condenser is placed on the roof of a building, this system is particularly useful. The arrangement, shown in Fig. 4, is similar to the system shown in Fig. 3 except that the refrigerant is allowed to pass through the liquid receiver. The refrigerant is emptied from the condenser into the receiver and is taken off the bottom of the receiver tank into the liquid line, which runs vertically downward toward the expansion valve and cooling coil. Due to the head of liquid refrigerant above the expansion valve the pressure on the refrigerant at the expansion valve is considerably higher than it is at the liquid receiver. If the liquid refrigerant leaves the liquid receiver in a saturated condition, the pressure on it increases while its temperature remains about constant, thus giving the effect of subcooling. The greater the vertical distance from the receiver to the expansion valve, the greater is the pressure of the refrigerant at the expansion valve and the greater means for subcooling need not be provided. The sight glass, to determine whether or not the liquid stream is solid, should be placed near the expansion valve.

City Air Searched for Sulphur

RESULTS of a 15-month air "inventory" to find the facts about amounts of sulphur gases in the air of American cities, long a subject of speculation and dispute, have been announced by Air Hygiene Foundation and Mellon Institute. The average amounts of sulphur fumes found in 25 cities studied were comparatively small.

More than 50,000 separate air tests were made by six chemists driving a fleet of traveling laboratories. They canvassed industrial and residential centers throughout the east, south and midwest, from August, 1936, to October, 1937. Most of the tests, covering all hours of day and night and all seasons of the year, were made in five metropolitan districts. The five, in the order of their sulphur dioxide pollution, within a 15-mile radius of the center of the city, are:

City	Parts of SO_2 per Million Parts of Air	
	Average	Maximum
St. Louis—E. St. Louis	0.128	2.266
Pittsburgh	0.057	0.897
Detroit	0.028	0.396
Philadelphia-Camden	0.027	0.424
Washington	0.009	0.290

These figures are of no significance from a public health standpoint, according to hygienists connected with the investigation. That is, in the concentrations found, the contaminants do not exert harmful physiological effects.

House heating fires are large contributors to sulphur pollution, particularly in districts using coal of high sulphur content. The type of coal burned in a district was mirrored in the results of the study. The fuel factor also explains why sulphur pollution in most districts was approximately 50% higher in the heating season than in the summer months. Some industrial processes also discharge sulphur fumes unless properly safeguarded.

A close relationship was found between wind velocity and the amount of sulphur dioxide in the air. Winds blow the pollutants away, consequently the higher the wind the cleaner the air. Fogs catch and "store up" the sulphur fumes. Some of the highest concentrations were found on foggy nights.

Occasional tests were made in a score of other cities. H. B. Meller, managing director of Air Hygiene Foundation, cautioned that results obtained in these cities *cannot be compared* with the findings for St. Louis, Pittsburgh, Detroit, Philadelphia-Camden, and Washington. He said that "only a few tests were made in the 20 cities—not enough to arrive at a typical, average figure, as in the case of the five centers which formed the mainspring of the survey." Results for the 20 other cities:

City	Summer Average	Winter Average
Baltimore	0.021	0.081
Chicago	0.067	0.091
Cleveland	0.064	0.081
Wheeling	0.070	.....
Nashville	0.028	0.093
Cincinnati	0.021	0.064
Buffalo	.....	0.044
Youngstown	0.049	0.026
Louisville	0.022	0.041
Ft. Wayne	0.028	.....
Richmond	0.009	0.047
Indianapolis	0.023	.....
Toledo	0.023	.....
Chattanooga	0.011	0.035
Springfield, Ill.	0.021	.....
Birmingham	0.017	0.017
Charlotte, N. C.	0.015	.....
Johnstown	0.014	.....
Harrisburg	0.011	.....
Atlanta	0.012	0.032

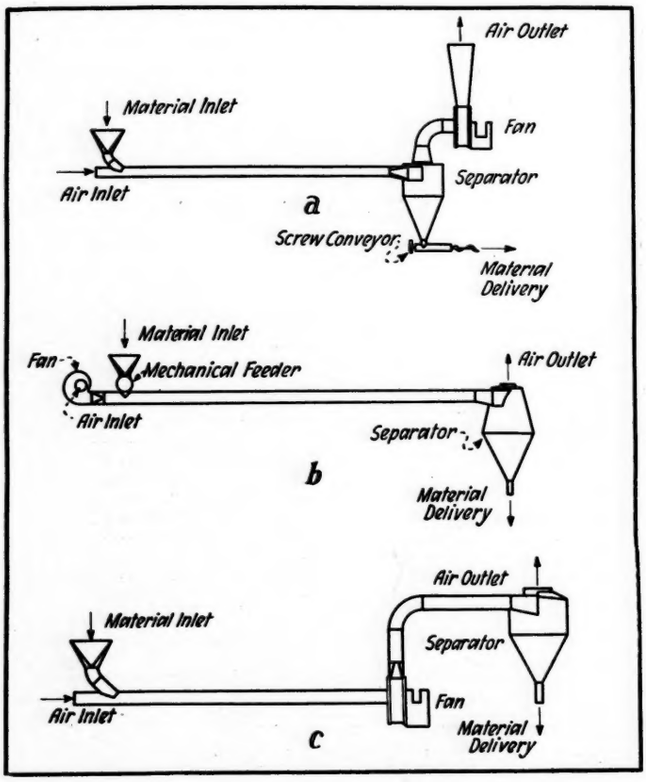
J. D. Alley directed the field work and compilation of data. Dr. J. L. Sherrick was in charge of the chemical laboratory. Both were Fellows on the Air Hygiene Foundation Fellowship at Mellon Institute. Six chemists were employed in the field.

Low Pressure Pneumatic Conveying Systems

By JOHN L. ALDEN

BULK materials which can be air-borne may be transported for considerable distances, both horizontally and vertically, by pneumatic conveying systems which are similar to ordinary dust collecting systems. These systems are simple, cheap and flexible. They will deliver material to almost any destination to which a pipe may be run. This characteristic favors the pneumatic conveyor for installation in existing buildings where plant arrangement and space limitations make other forms of material handling equipment difficult to apply. Pneumatic conveyors are dust-free and weather-proof and therefore may be run from building to building across plant yards and public streets without special protection and without causing public nuisance.

The mechanical efficiency of pneumatic conveyors is low. The resulting power consumption per ton of material sometimes offsets any advantages which pneumatic conveyors present. Moreover, the mile-a-minute velocities may shatter friable materials excessively by impact with pipe walls and elbows. For the same reason, abrasive substances may cause excessive wear of various parts of the system. While careful design and judicious selection of materials will minimize these effects, they are present to some extent in all pneumatic conveying systems.



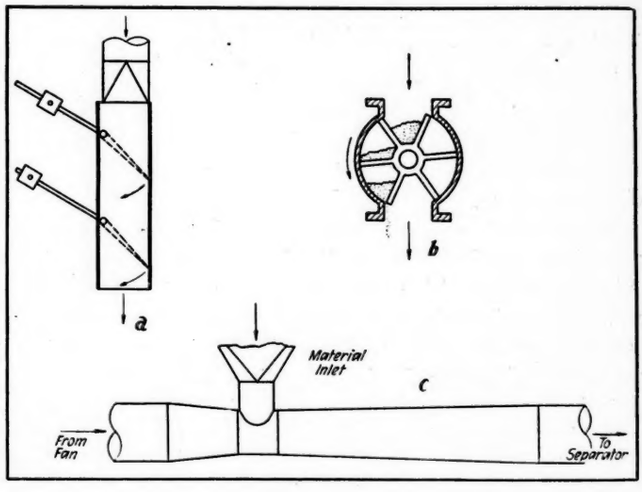
Conveying Velocities

The principles of design of pneumatic conveyors are identical with those of exhaust systems. Velocities, air volumes, pipe sizes and resistances must be determined. Economical velocities for pneumatic conveying are considerably higher than those employed in the dust collecting field. High velocities mean high conveying capacities. For a given pipe diameter, the material handling capacity increases with the cube of the velocity. The air volume itself increases directly with the velocity, whereas the weight of conveyed material per cubic foot of air varies with the square of the velocity. The combined effect, therefore, is strongly favorable to high air speeds.

Velocities must be selected with consideration for the nature and subsequent use of the conveyed material. Coffee beans, for example, must not be broken. Granulated sugar also is depreciated in value by shattering and dusting. Therefore, a nice balance must be struck between conveying economy and damage to the material. Cement, salt and bulk chemicals may be enhanced in value by the further attrition induced by the conveyor. No special consideration need be given most refuse materials such as wood waste or ashes since they neither improve nor deteriorate with pneumatic handling.

The lower limits of air speed are not far from those listed in Table 5 for dust collecting. These, of course,

Fig. 76 (Left). Basic types of low-pressure pneumatic conveyors. Fig. 77 (Below). Unloading and feeding devices.



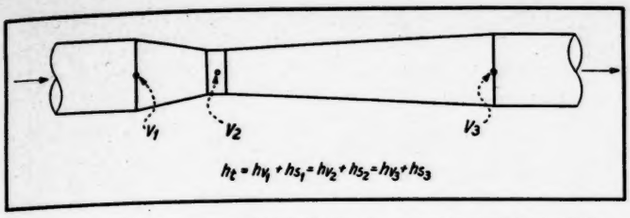


Fig. 78. Pressure relationships in simple venturi tube without losses.

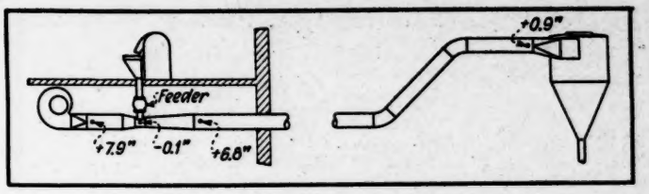


Fig. 79. Pressure conveying system.

are suitable only for systems in which the weight of solids per cubic foot of air is relatively low. In Table 20 is listed a similar group of materials and corresponding velocity ranges. The designer may use considerable discretion in the selection of velocities, preferably in the upward direction. The velocities in Table 20 are workable but as mentioned in connection with Table 5, they are not necessarily the most economical nor the most suitable for a given set of conditions. Often it is profitable to refigure a conveying system for several pipe sizes and velocities in order to establish the combination which is cheapest in the overall and which best fits the local conditions.

Air Volume per Pound of Conveyed Solids

Mechanical feeders which load the conveyor continuously and uniformly permit lower air flow rates per pound of material than does intermittent and irregular hand feeding. Hand feeding requires a flow rate sufficient to take care of the maximum slug of solids. The average concentration is seldom more than one third of the maximum.

Published data on the minimum air quantities for pneumatic conveying indicate the absence of systematic studies in this field. We are forced to depend upon experience and upon spot checks of existing systems. A typical test is one conducted to ascertain the rate of feed which would choke a system for conveying batched jute butts. Two experienced men fed a 30-in. pipe at the maximum rate they could sustain for 5 min. Although they fed 2000 lb. of damp fiber in this short period, they were unable to block the system. The average air velocity was 4300 f.p.m., corresponding to a flow rate of 53 cu. ft. of air per lb. of jute. It is believed that the system capacity is from 30% to 50% in excess of the feeding rate attained during the test.

Dense materials require less air per pound than do lighter and bulkier substances. From 35 to 50 cu. ft. per lb. should handle any material in Table 20 at the lower velocity quoted. It is probable that 15 to 20 cu. ft. is sufficient for the upper velocities listed. Mechanical feeds may cut these values in half if conditions are favorable.

TABLE 20.—VELOCITIES FOR LOW PRESSURE PNEUMATIC CONVEYING

Material	Velocity, F.P.M.	
	From	To
Wood flour	4000	6000
Sawdust	4000	6000
Hog waste	4500	6500
Pulp chips	4500	7000
Tanbark, dry	4500	7000
Tanbark, leached, damp	5500	7500
Cork, ground	3500	5500
Metal turnings	5000	7000
Cotton	4000	6000
Wool	4500	6000
Jute	4500	6000
Hemp	4500	6000
Rags	4500	6500
Cotton seed	4000	6000
Flour	3500	6000
Oats	4500	6000
Barley	5000	6500
Corn	5000	7000
Wheat	5000	7000
Rye	5000	7000
Coffee beans, stoned	3000	3500
Coffee beans, unstoned	3500	4000
Sugar	5000	6000
Salt	5500	7500
Coal, powdered	4000	5500
Ashes, clinkers, ground	6000	8500
Lime	5000	7000
Cement, Portland	6000	9000
Sand	6000	9000

Suction vs. Pressure Systems

Once the material is in the air stream, it makes no difference pneumatically whether the conveying pipe is under suction or pressure. Practically, there may be definite advantage in one over the other under certain circumstances. The designer can choose among three types of system. He may introduce the material through the suction pipe, trapping it before reaching the fan; introduce it into the discharge pipe against the fan pressure; or he may feed it on the suction side, pass it through the fan and separate it from the conveying air on the discharge side. Fig. 76 indicates the alternatives schematically.

As a rule, the selection of the preferred type of system is not difficult. To illustrate, it may be advantageous to use the suction as a means for getting the material into the system but the nature of the material may be such as to preclude passing it through the fan.

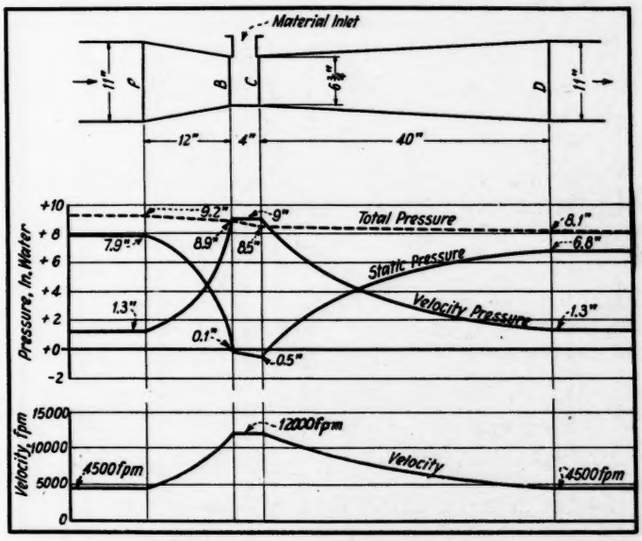


Fig. 80. Velocities and pressures in venturi charger.

Fig. 76a is then the correct type. Local conditions may dictate a fan location near the feeding point. Fragile materials then are best fed by mechanical charger into the pressure pipe beyond the fan. This is the arrangement shown in Fig. 76b. In other cases, such as the handling of coarse wood wastes, non-inflammable or non-abrasive materials, the conveyed matter may be passed through the fan without danger. In the last instance, any one of the three types will be satisfactory.

Leakage of pressure systems is always outward. Hence, poisonous and other hazardous substances should be conveyed entirely by suction wherever possible. Spark-proof bronze wheels and adequate tramp iron traps minimize fire hazards. The long shavings wheel or the one-piece, smooth wool wheel will pass large quantities of stringy materials without clogging or losing balance. The life of the fan may be improved by the use of chilled or white iron casing liners, by the use of hard alloys or by using extra thick casing sheets. By these and other expedients, the suction-pressure system, Fig. 76c, is enabled to invade the fields of the all-suction and all-pressure types.

Unloading and Feeding Devices

The dust discharge pipe of any separator operating under negative pressure must be sealed against the atmosphere. The entrance of air through the dust discharge would destroy the suction at the feeding point and would cause settlement in the pipes. If the separator is of the cyclone type, the admission of air through the dust outlet will interfere seriously with vortical separation. In Fig. 77a and b appear two forms of sealing device which permit the delivery of material without the entrance of air. Fig. 77a is a simple gravity dump of the airlock type. By adjustment of the counterweights, the valves may be made to dump under different loads so that only one valve is open at a time. Gravity unloaders deliver intermittently. A power-driven unloader such as Fig. 77b delivers continuously and is more positive in action than the gravity valve just described. The wear is moderate if the rotational speed is not excessive. The ordinary screw conveyor, also, is a satisfactory seal if the discharge end is kept submerged in material.

Pressure systems may be fed through seals similar to Fig. 77a and b or by screw conveyor. Another type is the venturi feeder, Fig. 77c. When constructed as part of the fan discharge pipe this device reduces the static pressure at the material inlet to atmospheric or below so that no inlet seal is needed. The venturi tube may be used alone or in combination with mechanical feeders like Fig. 77b. In the latter case the power-driven feed wheel functions solely as a metering device to regulate the flow of material into the system. Since it is no longer needed as a seal, clearances may be liberal and the wear reduced correspondingly.

Venturi Tube Theory

A simple venturi tube is shown in Fig. 78. It consists of convergent and divergent cones joined by a short parallel throat section. The pressure relationships in the various sections, for the condition of perfect pressure conversion, are shown in the illustration. These follow Bernouilli's theorem.† When the static and velocity pressures at the discharge end of the unit are known and the desired static pressure in the throat has been established, the throat velocity pressure may be obtained from the expression

$$h_{v_2} = h_{v_1} + \frac{h_{s_1} - h_{s_2}}{1 - k_1}$$

†Heating & Ventilating, September, 1937, pp. 41, 42.

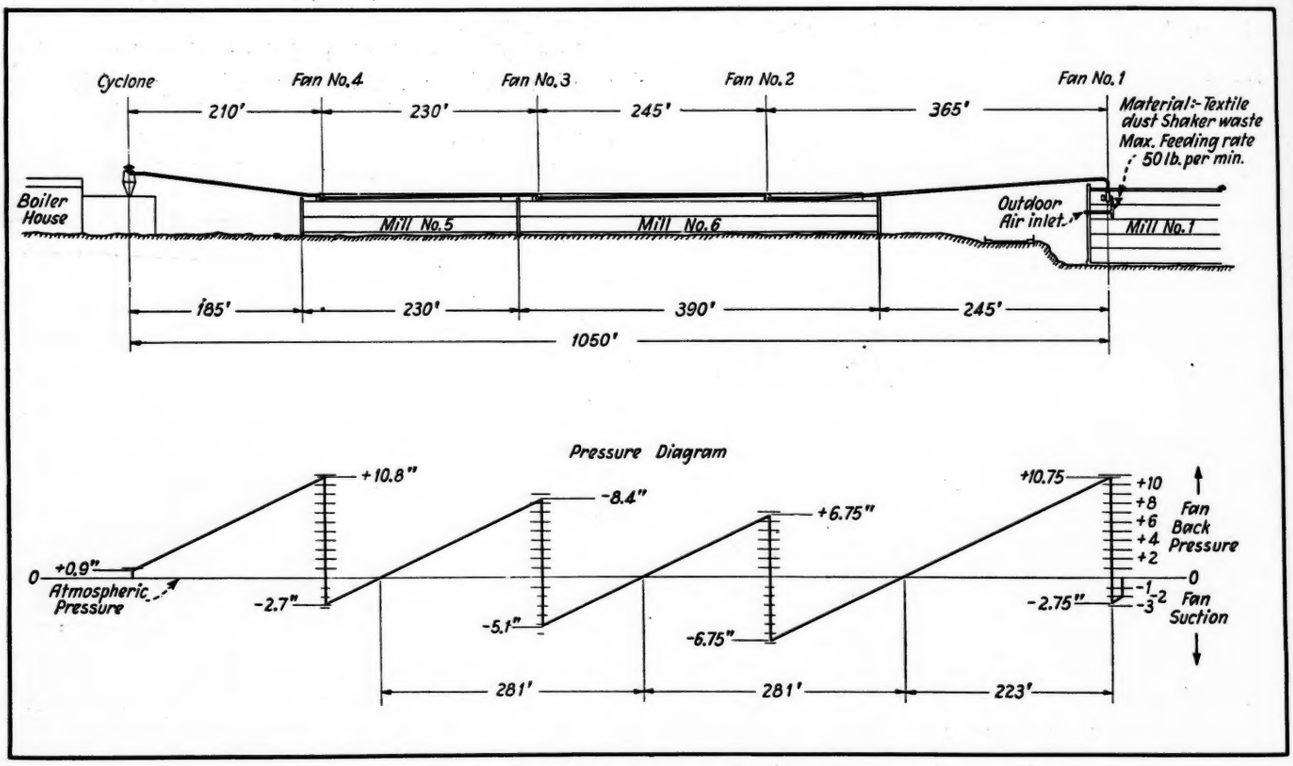
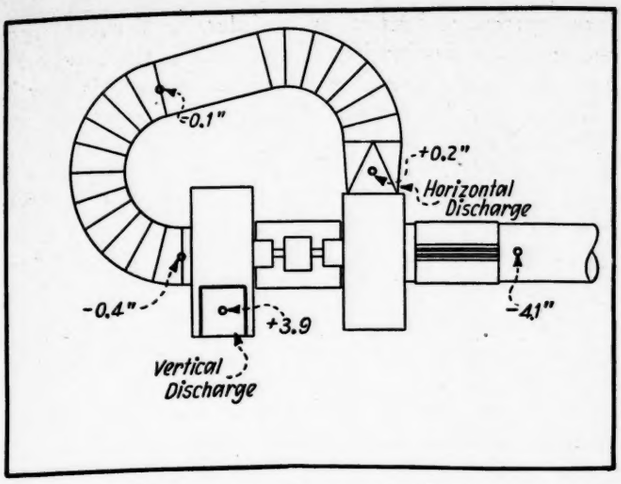


Fig. 81. Conveying system with tandem fans.



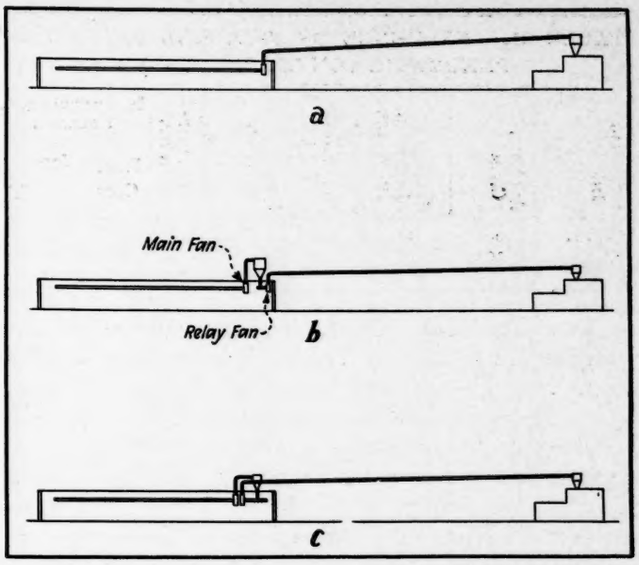


Fig. 82 (Above). Double fan connected as two-stage compound fan. Fig. 83 (Right). Relay systems.

where k_1 is the loss factor in tapered enlargements as taken from Fig. 54. The static pressure at the inlet includes the outlet static and all intermediate conversion losses. It is derived from the throat static and velocity pressures as follows:

$$h_{s_1} = h_{s_2} + (1 + k_2)(h_{v_2} - h_{v_1})$$

The constant, k_2, is the loss factor for tapered contractions and lies between 0.04 and 0.06 for included angles less than 45°.

Good proportions for venturi feeders are:

Entrance cone included angle, 20°
Discharge cone included angle, 6°
Throat length $\equiv$ throat diameter.

The process of computing throat diameter must start at the delivery end of the venturi since the only known factors are the discharge resistance, including collector back pressure, and the flow conditions downstream from the venturi. When the throat pressures have been established, the pressure against which the fan must work can be computed.

The venturi feeder differs from the simple venturi tube by the addition of a feeding hole in the wall of the throat. The presence of this opening introduces an additional loss because of the discontinuity of the throat surface and because of the admission of air and material at this point. For convenience, this loss may be included in the factor k_1 used in the computation of the throat velocity pressure. The loss factor taken from Fig. 54 may be increased by 0.05 to 0.10. The static pressure drop from inlet to outlet of a well designed venturi feeder is usually from 15% to 20% of the static pressure at the delivery end of the tube.

Typical All-Pressure Conveying System

There appears in Fig. 79 a typical system for conveying bulk granular material under pressure. The feeding device consists of a power wheel and venturi tube. The proportions of the latter are shown in enlarged detail in Fig. 80. The velocities in the entrance and exit cones and in the throat are shown in the lower diagram. The upper curves show the corresponding pressure changes.

Tandem Fans

The distance through which a conveying system can operate with a single fan is limited by the maximum static pressure difference which the fan can produce. This, in turn, is limited by the safe tip speed at which the wheel can be operated. If long, stringy materials such as rags, jute or hemp fiber or long damp shavings must be passed through the fan, it is best to limit the tip speed to about 10,000 f.p.m. This speed will produce a total static pressure (sum of inlet and discharge static pressures) approaching 8 in. of water. All-suction or all-pressure systems such as Fig. 76a and b permit maximum fan speeds. Well built and well balanced wheels may be run as fast as 15,000 f.p.m., producing static pressures of from 17 to 20 in. of water depending upon the blade design. If higher pressures are needed, two or more fans may be connected in series. When so connected, the pressures are additive. Thus, if two identical fans, run at equal speeds, are connected in tandem, the pressure difference between the inlet of the first and the outlet of the second is exactly twice that produced by either fan operated alone.

The general arrangement of a long distance conveying system using tandem fans is shown in Fig. 81. The drawing also shows a diagram of the static pressures present in the different parts of the system. So far as the building arrangement will permit, the fans are spaced so as to produce the smallest departure from atmospheric pressure. The greatest compression is 10.8 in. of water or about 2½% of atmospheric. The maximum rarefaction is nearer 1½%. Had the fans been concentrated near the inlet or near the collector, the compression or rarefaction might have reached 12% or more. The corresponding change in volume would have produced a progressive increase or diminution of velocity along the system.

Inspection of the pressure diagram shows that the static pressure passes through zero between the outlet of one fan and the inlet of the next. If material is to be introduced into the system at more than one point, these points of zero static pressure are the most favorable for preventing inward or outward leakage through mechanical chargers.

Double Fans in Tandem

Fig. 82 shows a double fan connected as a two-stage

TABLE 21.—INFLUENCE OF PIPE SIZE ON COST OF PNEUMATIC CONVEYING SYSTEM

Pipe Dia., In.	Air Vol., C.F.M.	Static Pressure, In. Water	No. Fans	Motor Size, Hp.	Total Power Consumption, Hp.	Increased Cost, Dollars, First Cost	Increased Cost, Dollars, Annual Power Cost
8....	1600	54	4	7½	25	0	0
16....	5300	18	2	15	27	1700	60
24....	11,300	11	1	35	35	3000	300

or compound fan. This system conveys textile fiber through a 30-in. pipe at the moderate velocity of 3500 f.p.m. It will be observed that the pressure drop through the cross-over connection is about 0.8 velocity head. The pressures shown were measured when the system was handling air only. Slugs of fiber passing through the system cause the pressures to fluctuate wildly. The pressure at the inlet of the second fan surges from about 2 in. of water below atmospheric to about 1.5 in. above. The changes are so rapid and violent that no accurate readings are possible with a water-filled manometer.

Belt-Driven Fans

Design uncertainties are considerable in most conveying systems. The friction loss when moving air only may vary 5% or more from the calculated amount. A further uncertainty is introduced by the factor applied from Fig. 45 to compensate for the effect of the conveyed solids on the friction loss. The combined error in calculated pressure may easily be as much as 10% of the total. In the long system shown in Fig. 81, the error may be more than 5 in. of water. The simplest means for bringing the pressures in line with the calculated values is to drive the fans through flat or "V" belts so that a simple and cheap pulley change will adjust the speeds as needed.

Economical Pipe Sizes

The smallest practicable pipe size should be specified for a pneumatic conveying system. The combination of small pipes and high velocities result in high friction losses but the carrying capacity of the system increases more rapidly than does the power consumption. Fans, separators and piping become smaller, cheaper and easier to install. The first estimate for the system in Fig. 81 proposed a 24-in. diameter pipe. As finally installed, an 8-in. pipe was used. Table 21 gives comparative data for this system as calculated for three pipe sizes.

Relay Systems

When a number of dust collecting systems or a single large system is located at considerable distance from the ultimate destination of the refuse, there may be economy in the use of a relay fan. Large air flow is necessary for dust control purposes but results in a low dust loading per cubic foot of air. If the material can be separated from the air used for its collection at a point close to its origin, a smaller system of the high velocity conveyor type can be used to deliver it to its remote destination. Fig. 83a shows a conventional dust gathering system delivering the collected refuse to a cyclone on a remote building. In Fig. 83b the main cyclone has been placed near the primary fan. The concentrated refuse then feeds from the main cyclone to the inlet of a small fan which blows the material across the yard into a correspondingly small cyclone.

The relay system is recognition of the dual function of a dust collecting system, namely, dust control and dust conveying. While each situation must be analyzed individually, it may be said that a system handling 15,000 c.f.m. for a discharge distance of 200 ft. or more usually can be broken into a gathering unit and a conveying unit.

Fig. 83c represents a double fan, one side of which is used as a relay fan. As a rule, this is not as cheap an installation as that employing a separate small fan since it does not take full advantage of the possible reduction in pipe diameter and cyclone size. If several gathering systems are located in the same building, one of the smaller units may be used as a relay system for the remainder. Also, when rearranging or enlarging existing systems, the possibility of using part of the present installation as a relay system should not be overlooked. The alternative arrangements should be sketched roughly and the more promising ones estimated in detail for first cost and power consumption.

Special Considerations for Conveying and Relay Systems

Systems employing two or more fans must be operated by definite schedule. The most remote fan must start first or some positive means must be adopted to prevent feeding material into the system before adequate conveying velocities are built up in all pipes. Ample handholes and cleanouts must be provided. They are not needed often if the system is designed properly but they save expense and damage to the system in cases of accidental clogging. When handling fibrous or hygroscopic materials, the conveying air should not be taken from warm and humid rooms. Exposed runs of piping will sweat internally in cold weather and will be difficult to keep clear. If possible, the conveying air should be drawn from outside.

High Human Body Temperatures

IN a recent issue of the Journal of the American Medical Association, Dr. W. D. Reid of Boston reports on a study made of the highest temperature that the human body can reach and survive. The study covered 158 cases of heat prostration in the Boston City Hospital. The following table is from the study:

Temperature, F.	Cases	Deaths
—105	10	1
105—106	8	4
106—107	8	5
107—108	6	6
108—109	14	10
109—110	15	12

The high mortality, 58%, in these cases of heat stroke was doubtless influenced by the complications: At admission to the hospital: alcoholism, failing heart, edema of the lungs and convulsions. Subsequent: delirium tremens, persistent coma, pneumonia and recurrence of fever.

Average Maximum Daily Temperature for July

In connection with design and operation of summer air conditioning equipment, engineers are concerned not only with extreme conditions which have prevailed in a given locality but also in a number of different average figures available directly or derived from Weather Bureau data. There are two reasons for this.

Summer Conditions Not Fixed

First, in winter, residents in the United States are accustomed to an indoor temperature of not less than 70F during their waking hours; in summer there is no such fixed temperature which must be met to meet comfort requirements. In other words summer air conditioning equipment, while it can be installed to meet any given extreme temperature which may be encountered, is rarely so installed due to the fact that not only the dry bulb temperature but the humidity as well affects comfort during the summer perhaps more sharply than it does in the winter. Since there is no arbitrary condition to be met the designer is frequently concerned with using average extreme conditions as the basis of his design.

Second, the matter of cost in summer air conditioning enters more strongly into the picture, since an increment of five degrees of summer air conditioning increases the cost more sharply in percentage than a five degree increase would in winter conditioning design.

What the Map and Table Show

Consequently, there are presented here data on one of the averages which is of interest to the summer air conditioning engineer, namely, the average daily maximum temperatures for July. Using these data the engineer should keep in mind exactly what this phrase implies. The following explanation will make the definition clear.

First order weather stations take readings of the dry bulb temperatures every hour. These are usually made available to the public in condensed form by giving for each day the maximum dry bulb temperature reached that day, together with the minimum dry bulb temperature and also the mean of the two.

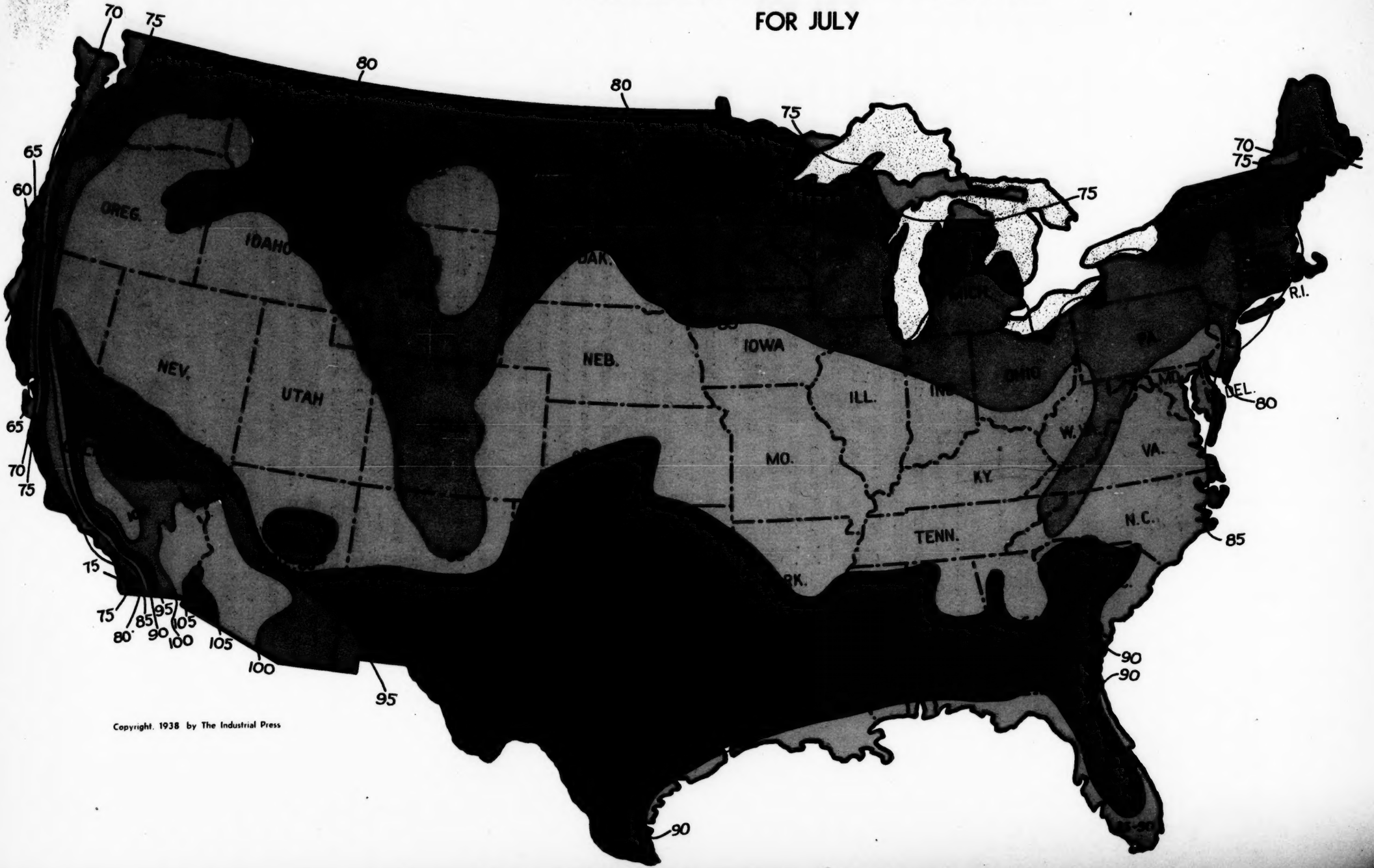
Definitions

At the end of the month the average of all the mean temperatures is given; this is the mean daily temperature for that particular month and station. The averages of all the maximums and all the minimums for the month are likewise given. The average of all these maximums is consequently the average of the highest temperatures attained each day throughout the month for that station. Such figures apply only to the year in question.

If then the average maximum temperatures for all the Julys for which records are available are in turn averaged the result is the average daily maximum temperatures for July and these are the data

Text continues following Map and Table.

AVERAGE DAILY MAXIMUM TEMPERATURES FOR JULY



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AVERAGE MAXIMUM, MINIMUM AND MEAN TEMPERATURES FOR JULY IN 100 CITIES

	Mean Max., F.	Mean Min., F.	Mean, F.
Albany, New York	82.3	63.1	72.3
Albuquerque, New Mexico	89.9	62.1	76.0
Atlanta, Georgia	86.7	69.5	78.4
Baltimore, Maryland	85.8	69.1	77.4
Birmingham, Alabama	89.2	70.4	80.0
Boise, Idaho	89.1	57.1	73.1
Boston, Massachusetts	80.5	63.6	72.0
Buffalo, New York	76.6	63.0	69.8
Burlington, Vermont	76.8	63.1	70.0
Butte, Montana	78.2	49.8	64.0
Charleston, South Carolina	88.0	75.1	81.3
Charlotte, North Carolina	87.7	69.0	78.4
Cheyenne, Wyoming	80.8	52.9	66.8
Chicago, Illinois	79.7	65.7	72.7
Cincinnati, Ohio	86.5	68.0	77.2
Cleveland, Ohio	78.9	64.3	71.8
Columbia, South Carolina	90.0	70.7	80.3
Columbus, Ohio	85.2	65.1	75.1
Concord, New Hampshire	81.0	58.6	69.8
Dallas, Texas	94.1	74.6	84.0
Denver, Colorado	85.4	58.5	72.0
Des Moines, Iowa	85.7	65.0	75.4
Detroit, Michigan	81.1	62.9	72.2
Duluth, Minnesota	74.4	56.3	65.4
El Paso, Texas	94.0	69.0	81.6
Erie, Pennsylvania	78.3	64.1	71.2
Eugene, Oregon	80.1	51.4	65.8
Evansville, Indiana	88.4	69.8	79.1
Fitchburg, Massachusetts	81.0	60.9	71.0
Flagstaff, Arizona	79.8	50.5	65.2
Fort Smith, Arkansas	91.7	70.4	80.1
Fort Wayne, Indiana	85.5	62.2	73.9
Frederick, Maryland	87.5	65.3	76.2
Grand Forks, North Dakota	79.7	55.0	67.4
Grand Rapids, Michigan	83.1	61.9	72.5
Great Falls, Montana	83.1	53.9	68.5
Greensboro, North Carolina	88.5	67.5	77.8
Hartford, Connecticut	82.3	63.2	72.8
Houston, Texas	92.4	73.9	83.3
Huntington, West Virginia	88.0	65.1	76.4
Indianapolis, Indiana	85.5	66.7	76.1
Jacksonville, Florida	90.0	73.8	81.9
Kansas City, Missouri	87.2	69.1	78.2
Knoxville, Tennessee	86.9	67.5	77.0
Lexington, Kentucky	85.0	66.8	75.9
Lincoln, Nebraska	87.8	65.6	76.6
Little Rock, Arkansas	89.8	71.8	80.8
Los Angeles, California	81.4	59.0	70.2
Louisville, Kentucky	88.2	69.4	78.8
Madison, Wisconsin	81.3	62.8	72.1

	Mean, Max., F.	Mean Min., F.	Mean F.
Memphis, Tennessee	89.0	72.5	80.8
Meridian, Mississippi	89.5	69.6	79.7
Milwaukee, Wisconsin	78.1	62.0	70.0
Minneapolis, Minnesota	81.7	62.5	72.1
Minot, North Dakota	82.2	53.4	68.1
Mobile, Alabama	89.5	74.0	81.4
Newark, New Jersey	84.1	65.4	74.6
New Orleans, Louisiana	—	—	82.3
New York, New York	81.9	66.7	74.3
Norfolk, Virginia	86.8	70.5	78.6
Oklahoma City, Oklahoma	89.5	69.3	81.2
Omaha, Nebraska	86.3	67.0	76.6
Paterson, New Jersey	85.0	64.5	74.4
Pensacola, Florida	86.8	74.7	80.8
Peoria, Illinois	—	—	74.3
Philadelphia, Pennsylvania	84.5	68.1	76.5
Phoenix, Arizona	102.4	76.0	89.2
Pittsburgh, Pennsylvania	84.3	64.9	74.7
Portland, Maine	76.0	60.0	68.0
Portland, Oregon	77.9	56.1	67.0
Providence, Rhode Island	80.9	63.0	72.0
Pueblo, Colorado	88.2	59.8	74.0
Reading, Pennsylvania	85.5	64.9	74.9
Reno, Nevada	86.8	52.2	69.5
Richmond, Virginia	87.8	68.6	78.1
Rochester, New York	80.3	61.7	70.9
St. Louis, Missouri	87.9	52.2	69.5
Salt Lake City, Utah	87.9	63.2	75.6
San Antonio, Texas	94.0	72.9	83.5
San Diego, California	72.3	62.2	68.1
San Francisco, California	64.7	52.5	58.5
Savannah, Georgia	89.6	73.5	81.5
Scranton, Pennsylvania	82.0	61.7	72.1
Seattle, Washington	72.9	54.5	63.7
Shreveport, Louisiana	92.4	73.2	82.9
Sioux City, Iowa	85.0	63.7	74.4
Sioux Falls, South Dakota	84.9	59.7	72.3
South Bend, Indiana	84.7	62.3	73.5
Spokane, Washington	83.3	55.5	69.5
Springfield, Illinois	86.7	66.5	76.6
Syracuse, New York	78.9	61.6	70.3
Topeka, Kansas	88.7	67.3	77.6
Trenton, New Jersey	85.0	66.6	75.8
Tulsa, Oklahoma	93.8	69.5	81.6
Vicksburg, Mississippi	90.0	72.4	81.3
Washington, Dist. of Col.	86.4	67.6	76.8
Wheeling, West Virginia	88.6	61.1	74.9
Wichita, Kansas	89.8	68.6	79.0
Wilmington, Delaware	86.1	67.5	76.8
Yuma, Arizona	105.3	76.5	90.8

which are plotted in the accompanying map and presented for 100 of the largest cities in the table. The table also gives the average minimum and mean temperatures for July.

Use of the Data

Consequently a summer air conditioning system can be expected to operate through July against an average maximum temperature as given. This does not mean that the most severe conditions encountered will be this figure by any means. Neither does it mean that it will operate at this figure every day in the month but it does mean that the outside conditions will average at this figure for at least one hour every day. It should be noted that the temperatures given are dry bulb temperatures—those read on an ordinary thermometer. The data are entirely independent of any wet bulb temperatures which may exist in these localities.

July has been chosen rather than August inasmuch as July ordinarily is the hottest month in all parts of the United States with the exception of the southern part of the Pacific Coast where midsummer comes somewhat later.

Effects of Bodies of Water

The effects of large bodies of water are clearly shown on the map. The effect of the Gulf Stream in the Atlantic Ocean is to pull down the temperature lines somewhat. Similarly, Lake Erie and Lake Michigan reduce the average temperature through July. It is particularly interesting to note that along the Gulf of Mexico and in southern Florida the temperature is reduced sufficiently to bring the July maximum average up to a point corresponding with localities far to the North but in the interior.

Pacific Coast Region

Along the Pacific Coast the ocean currents flow from North to South. As they flow South along the Pacific Coast that part of the United States in line with the currents and which juts out into the Pacific is somewhat cooled. The effects of this are shown on the map where the northern part of California has a lower daily maximum in July than does Seattle and adjacent cities which are farther North but protected from the ocean currents.

The extremely complex character of the topography of the so-called Rocky Mountain states has made it necessary to generalize the map in these regions.

Hot Water Electric Boiler for Central Heating

TWO recent installations have been carried out on central heating plants, equipped with hot water electric boilers built for the same conditions of output and operation, namely 250 kw. maximum continuous power input, corresponding to 833,350 B.t.u. per hr. at 380 volts and 50 cycles. The only difference between the two plants is in the height of the water column of the heating system and in the temperatures of the initial flow and of the return flow of water. However, these factors have no great influence on the output.

Fig. 1 is a section of the hot water electric boiler, and Fig. 2 gives the fundamental diagram of the complete plant with the electric connections of the boiler and auxiliary drives. The electrodes (Fig. 1), suspended to the cover by means of bushing insulators, are immersed in the water. The electric current flows from the electrodes through the boiler water and heats the latter. If the boiler is supplied with a large amount of water, it will take more power, while a low level of water in the boiler corresponds to a low power input. It is possible to regulate the load gradually, from 0 to 100% of the full rating.

The water in the boiler is heated to the saturation temperature corresponding to the height of the water column measured up to the expansion tank (Fig. 2). In this way and according to the water column, the following temperatures are attained:

Height, Ft.....	15	30	45	60	75	90
Temperature, F ..	230	250	260	270	280	290

Steam forms in the upper part of the boiler, which is condensed by the water introduced through the injection nozzle. If the heating requirements drop, the temperature of the water injected goes up first. The pressure exerted by the cushion of steam rises and a part of the water in the boiler is expelled to the expansion tank through the compensating tank. This causes the level of water in the boiler to drop and the power input drops, as well, until equilibrium is again established between the power input and the power delivered. If, on the contrary, more heat is drawn from the boiler than corresponds to the electric power input, all the steam is condensed. This causes the pressure to drop, and water flows in again from the expansion tank until the power input has gone up so far that it corresponds to the increased heat delivery.

As the water available in the boiler is too hot to be used directly in the central heating system, it must be mixed with the return flow water from the central heating system, and in such a way that the resultant mixture attains the temperature desired for the initial flow. Just after the pump, a part of the water of the initial flow is led back to the boiler through governing valves where it is brought up to boiling temperature. Thus, with constant initial flow temperature, the power input to the boiler is directly proportional to the amount of water supplied.

A determined temperature, fixed in advance for the initial flow, is maintained automatically by the thermostats in connection with the motor valve. Valve 12 can be so adjusted by hand that a certain maximum amount of water cannot be exceeded. This valve thus operates as a power input limiter. The second valve, 12a, and the motor valve, 13, serve to limit a determined maximum input during certain periods, this in combination with the clockwork switch; the input in question is set by means of valve 12a. During the controlled period, valve 13 is closed and valve 12a only lets so much water through as corresponds to the limited input adjusted for. After this controlled period is over, valve 13 is opened again, so that the duty of limiting the load is taken over by valve 12. For inputs lower than the limit value set, thermostat valve 11 does the regulating. The thermostat could be replaced by an air thermostat, placed in a room, so that the power input to the boiler would be regulated to constant room temperature, if desired.

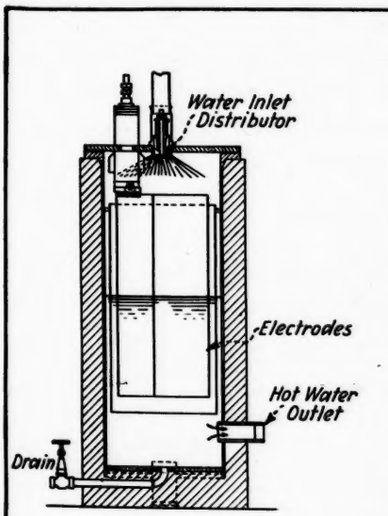

Fig 1

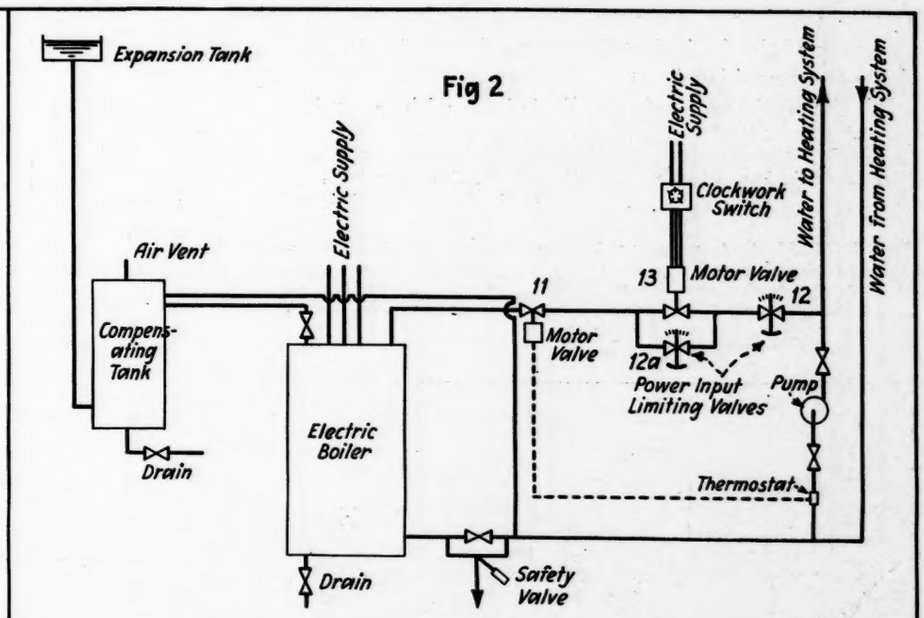

Fig 2

Performance of Automatic Air Controls of Small Underfeed Stokers

By H. R. LIMBACHER†

Automatic air controls for stokers are a recent development of much interest, and many of them were described in "Heating & Ventilating" in the September and November, 1936 issues. Since that time laboratory studies on the performance of such controls have been made at Battelle. The author presents their performance characteristics and shows that these controls generally do succeed in modifying the fan performance as their designers intend them to do.

THE purpose of the automatic air controls with which many manufacturers have equipped their small underfeed stokers is to modify the natural characteristic of the centrifugal fan to deliver less air as the static pressure against which the fan operates is increased. The resistance of a fuel bed does not remain constant even if the rate of supply of air and of coal is maintained constant. Caking of the coal, accumulations of fine green coal over the tuyeres, or accumulations of ash or clinker may increase the resistance. Shrinkage of coke away from the tuyeres, a temporary supply of coarse coal, or an unusual rate of combustion during an "off" period of the stoker may decrease the resistance.

With a fixed damper setting for control of the rate of supply of air, these changes in fuel bed resistance will mean a change in the rate of delivery of air. The changes occur in the direction to aggravate the cause of the disturbance. For example, if the resistance of the fuel bed increases for any reason, the delivery of air is decreased; this decreases the rate of burning, increases the thickness of the fuel bed and its resistance, and the supply of air is decreased even more. A vicious circle results which can often be stopped only by manual stoppage of the feed of coal until the fuel bed is burned down to normal level.

If the resistance of the fuel bed with a stoker equipped with a properly operating automatic air control increases for any reason, the rate of air supply is either maintained constant or increased, dependent on the design of the device, and the fuel bed is brought back to normal conditions. If the resistance of the bed becomes low, as it often does after a prolonged "off" period, the automatic control will maintain a uniform rate of supply or decrease the supply until the fuel bed has been built up to normal level by the feeding of coal.

The controls also operate to decrease the loss of fly ash and carbon from the fuel bed and their deposit on the heating surfaces by the blasts of air through holes in the fire that may form under some conditions.

Small stokers are sold in a highly competitive market and automatic controls must be simple and possible to manufacture at low cost. Because of this, some have questioned whether the controls function in the manner intended. In connection with the research on the characteristics of coal for small stokers in the laboratories of Bituminous Coal Research, Inc., at Battelle Memorial Institute, the testing method used has included the

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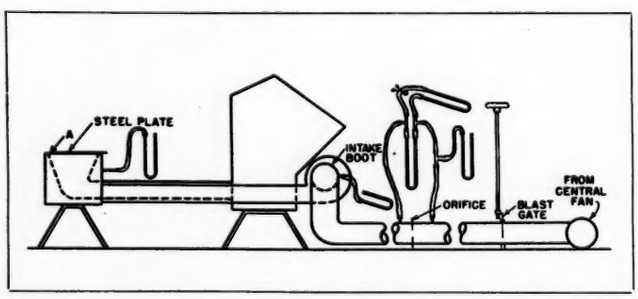
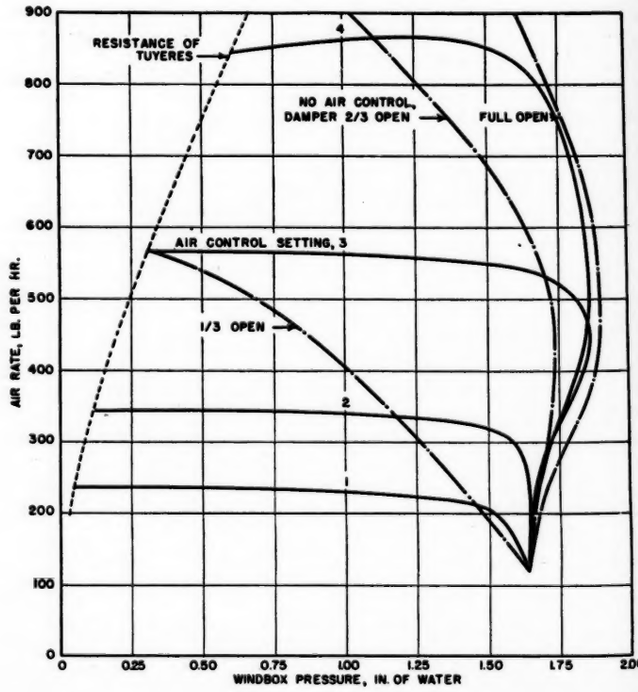
Fig. 1 (Below). Arrangement of equipment for determination of performance characteristics of automatic air controls. Fig. 2 (Right). Characteristics of a control intended to maintain a uniform air delivery as the wind-box pressure varies.





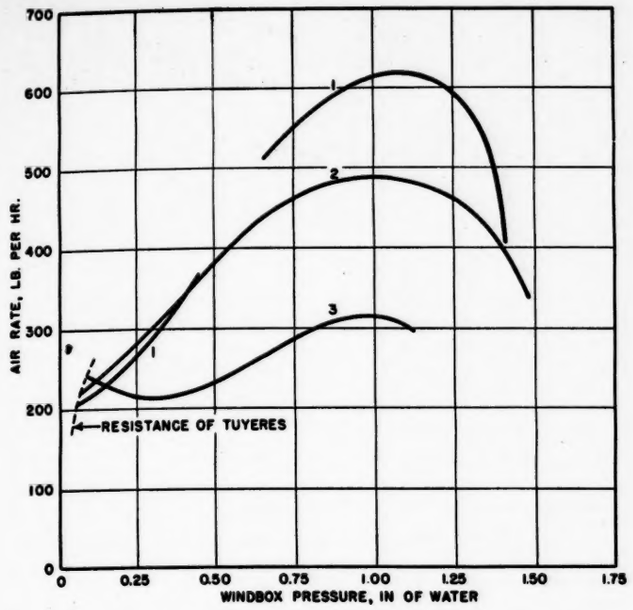


Fig. 3. Performance characteristics of three adjustments of a control where the air delivery increases as the wind-box pressure increases.

measurement of the air delivered by the stoker fan. Data have been accumulated on the performance of five typical residential stokers whose nominal maximum capacity is 20 to 50 lb. of coal per hr. This report presents a description, the methods of testing and the performance data on each of the controls. [Air control devices and their methods of operation were described in HEATING & VENTILATING in the September, 1936 issue on page 50, and in the November, 1936 issue on page 29.—Editor.]

Method of Testing

Fig. 1 shows schematically the arrangement of the apparatus for the determination of the performance characteristics of the air controls. It consists essentially of a duct arrangement that includes a thin-plate orifice for the measurement of the rate of flow of air and a simple arrangement for variation of the resistance against which the fan operates.

The duct for the supply of the air is connected to the inlet of the fan through a sheet metal chamber, or intake boot, applied to the intake of the fan. If the pressure drop across the thin-plate orifice had to be overcome by the stoker fan, the capacity of the fan would be reduced. This pressure drop was, therefore, supplied from another fan and the pressure within the intake boot was maintained equal to that of the atmosphere; in this way, the stoker fan operated normally.

Some leakage of air always occurs through the opening in the fan housing on the shaft side. To insure the measurement of all of the air that entered the fan, this opening was sealed by means of a felt packing ring.

To determine the resistance of the tuyeres to the flow of air, the stoker was set up as normally installed in a furnace and a set of readings of the flow of air for each of several settings of the automatic control was made. The resistance of the tuyeres alone is of value to determine the fraction due to the tuyeres and the fraction due to the fuel bed under any operating condition.

For the determination of the characteristics of the control at various wind-box pressures, all holes on the outside of the retort were sealed and a steel plate was placed over the top of the retort. The resistance was varied by changing the width of the opening, A.

A series of readings was taken for various settings of the air control by starting with the lowest wind-box pressure and going gradually to the maximum pressure and then gradually back again to the minimum wind-box pressure. The final curve is drawn as the average of the two sets of readings.

Characteristics of Air Controls

Figs. 2 to 6, inclusive, show the relation between the static pressure and the air delivery for different settings of the air controls for the five automatic controls. The end of each curve at the left marks the minimum resistance of the tuyeres with no fuel bed for that rate of delivery of air.

The rate of air supply is given in pounds per hour rather than in the more conventional manner of cubic feet per minute. Stokers are normally rated in feeding or burning rate in pounds of coal per hour. As each pound of coal requires, with no excess, from 9 to 11 lb. of air, the expression of the rate of air supply in pounds per hour permits of more direct correlation with the feeding rate than does its expression in cubic feet per minute. For conversion of air in pounds per hour to cubic feet per minute of normal dry air at 70F, having a density of 0.075 lb. per cu. ft., the weight is multiplied by 0.222.

Fig. 2 shows the characteristics of a control that was designed to maintain a uniform delivery of air as the wind-box pressure varied. How well it did this can be seen by comparison of the solid curves with the dot-dash curves which show the characteristics of the fan

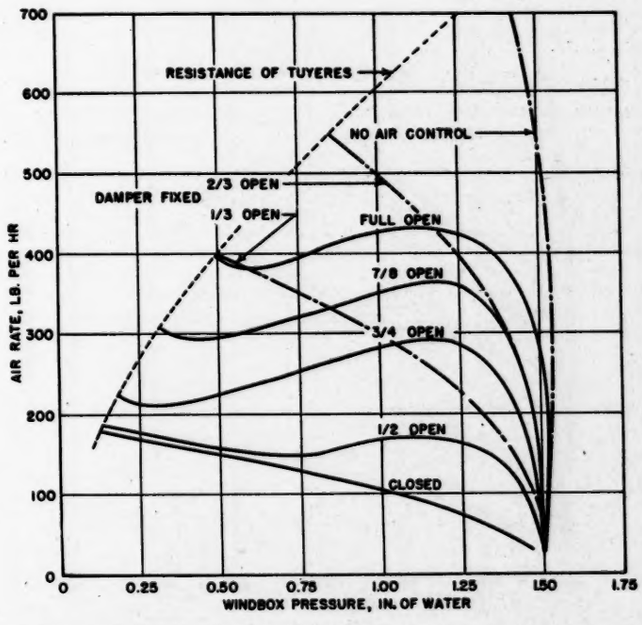


Fig. 4. Performance characteristics of an air control with rising air rate as wind-box pressure rises.

with fixed positions of the damper. With the damper fixed at one-third open, the delivery to the fuel bed would be 550 lb. per hr. if the resistance of the fuel bed was 0.5 in. of water, but the delivery would decrease to 300 lb. per hr. if the resistance rose to 1.25 in. With the automatic air control set to slightly less than the No. 3 position, the rate of 550 lb. per hr. would be maintained almost constant up to the cut-off pressure of the fan, somewhat over 1.5 in.

Fig. 3 presents curves of three adjustments of an air control that had a rising characteristic, that is, as the wind-box pressure increased, the rate of delivery of air increased. The break in curve 1 resulted from instability of the control at that setting; at other settings, the control was stable. The maximum delivery and the cut-off pressure of this fan were lower than those of the fan of Fig. 2 although the rated capacities of the two stokers were similar.

Fig. 4 gives characteristic curves for another automatic air control that increased the delivery of air with increase in wind-box pressure. How effectively the control modified the natural characteristics of the fan can be seen by comparison of the solid curves and the dot-dash curves. The position of termination of the curves at the left shows that the resistance of the tuyeres of this stoker was relatively high as compared to the stokers shown in Figs. 2 and 3. For example, the wind-box pressure required for a delivery of 400 lb. of air per hr. was 0.5 in. for the stoker of Fig. 4 but was less than 0.2 in. for the stoker of Fig. 2.

Fig. 5 presents performance curves of the automatic air control on a stoker that had two fan speeds, 1750 and 1550 r.p.m. Although the increased speed gave a higher cut-off pressure both with and without the control in operation and a higher rate of air delivery without the control, the automatic control maintained closely the same air delivery over a wide range at either speed. The curves were somewhat irregular but the tendency was for an increase in delivery with increase in the wind-box pressure. Although this stoker was rated and would feed 50 lb. of coal per hr., the maximum delivery of air was only about 450 lb. per hr., or less than the theoretical requirements. The ends of the curves at the left at less than 0.1 in. wind-box pressure show that the resistance of the tuyeres was very low.

Fig. 6 illustrates characteristic curves for the only air control of the five tested that did not materially change

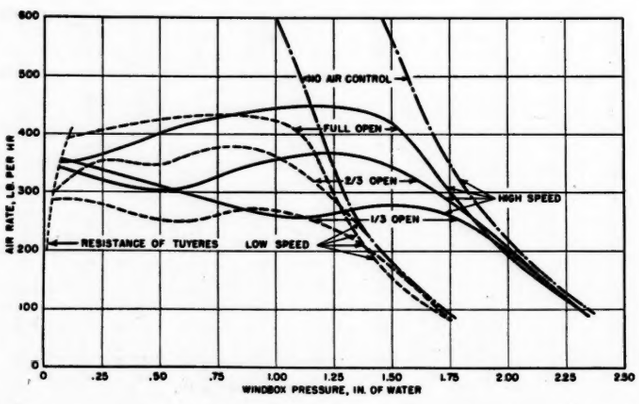


Fig. 5. Performance curves of an automatic air control on a stoker having a two-speed fan.

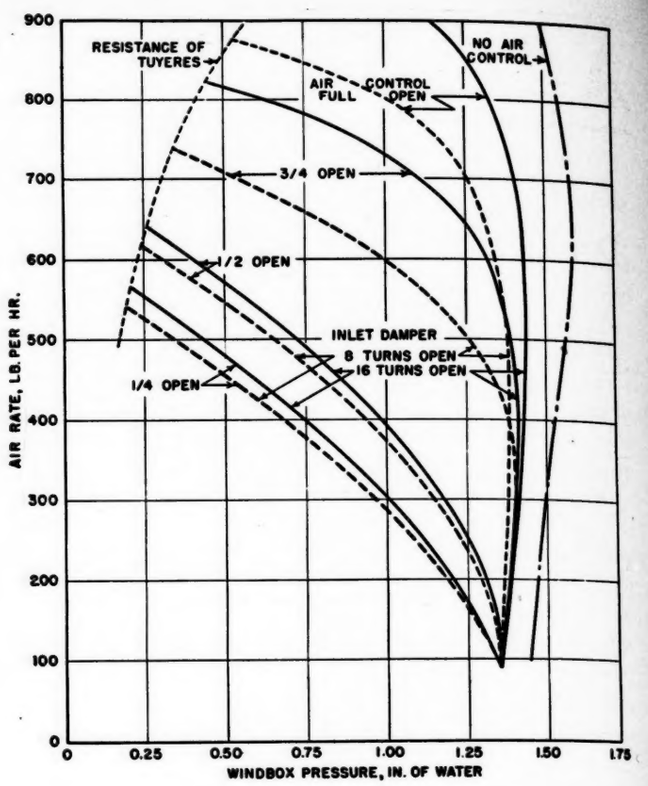


Fig. 6. Performance of an air control having falling characteristics.

the characteristics of a throttled fan although it did change the delivery for a given setting of the inlet damper. The fan had more than ample capacity for the feed rate of the stoker and it was necessary to restrict the inlet greatly to reduce the delivery of air enough for low feed rates.

Summary

The data obtained on the performance of the five typical automatic air controls for small stokers show that, in general, the controls function as they are designed to function. Only one of the controls failed to modify appreciably the natural characteristics of the centrifugal fan on the stoker. The other four controls either maintained a uniform rate of air supply or increased the rate of air supply as the wind-box pressure increased.

Although it cannot be safely assumed that all automatic air controls function as well as those tested, the results show that simple, dependable devices can be designed and built at the low cost required for application to small stokers.

Acknowledgments

This investigation was conducted under the supervision of Ralph A. Sherman, supervisor, Fuels Research Laboratories, Bituminous Coal Research, Inc., Battelle Memorial Institute. The suggestions of the Technical Advisory Committee, J. B. Morrow, chairman, John Fielding, Jr., C. A. Reed, and J. E. Tobey, have been most helpful. The stokers used in the tests were furnished through the courtesy of their manufacturers whose cooperation is gratefully acknowledged.

ABSTRACTS of Current Papers, Books and Pamphlets

Life, Heat and Altitude

As the science of air conditioning becomes more developed, greater attention is being paid to the physiological effects of atmosphere changes on the health and feeling of comfort of man. Because of this many air conditioning engineers will be interested in this book, which has for its purpose a presentation of information relative to the physiological responses of living organisms to stress, particularly those due to high temperatures and great heights.

While the amount of direct usable knowledge which the air conditioning engineer will secure from this book will probably be small, he will undoubtedly receive background knowledge which will help him understand more clearly why the human reacts as he does and why certain conditions must be maintained. In other words, this book will give him knowledge not obtainable in the usual air conditioning book which should make him better understand the basic principles of air conditioning. The chapters on energy exchange and perspiration are recommended for special attention. The chapters on man in hot climates, man in high altitudes and high altitude flight will probably be also of considerable interest.

[*"Life, Heat, and Altitude," by David Bruce Dill. Published by the Harvard University Press, Cambridge, Mass. Cloth cover; 5½ x 8 in.; 211 pages; price, $2.50.*]

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Arc Welding Manual

In order to keep pace with the progress of the arc welding industry, a third and completely revised edition of the Arc Welding Manual has been published. While the book has been written so as to avoid technical terms and discussions as much as possible, it should appeal to experienced operators and technicians as well as beginners because of the large amount of information included.

In the forepart of the book information for those who are merely seeking to learn more about the arc welding process and its applications will be found. In the latter part will be found more detailed instructions, exercises and tables and other helpful information for those who are interested in acquiring proficiency in actual use of the welding arc.

The book is divided into five sections entitled as follows: General Information; Practical Welding Lessons; Carbon Arc Welding and Cutting; Instructions for Welding Other Metals; and Special Information for Welding Operators and Designers.

[*"Arc Welding and How to Use It," third edition, by W. J. Chaffee. Published by The Hobart Brothers Co., Box EW58, Troy, Ohio. Flexible binding; 5½ x 8 in., 340 pages, including an equipment section; price, $1.50.*]

Uniform Stoker Ratings

Rapidly increasing sales of small underfeed stokers for residential heating and commercial and industrial application during the past few years has created a need for engineering standards covering application of the equipment to help overcome the confusion now prevalent in the trade.

In order to remedy this situation and as the first step in the Stoker Manufacturers' Association program of standardization, a standard stoker rating formula has been prepared by the Engineering Committee and officially adopted by the members of the Association. This formula is established as the standard method in determining the size of stokers for heating boilers and furnaces from sizes installed in small residential heating boilers and furnaces up to stokers with a burning rate of 1200 lb. of bituminous coal per hour.

The standard formula is simply stated as the size of the stoker in pounds of coal (burning rate per hour) equals the load in B.t.u. per hour divided by the heating value of the coal as burned times the overall efficiency of the stoker and boiler or furnace; in other words, the capacity of the stoker multiplied by the efficiency of its operation. This standard also provides that the factor to be added to the equivalent radiator surface load shall be not less than 33%. Where unusual conditions prevail, such as in schools, churches or other structures that are allowed to cool for extended periods of time and where unusually heavy pickup loads are necessary, this figure may be higher.

While this standard rating method was adopted by the Stoker Manufacturers' Association late last year, its release and publication was delayed pending the preparation of considerable interpretive data. These data in the form of definitions, charts and a complete table covering all sizes of stokers up to 1200 lb. of coal per hour capacity, along with detailed explanations on how to use the charts and table, are incorporated in the booklet.

[*"S.M.A. Uniform Stoker Rating," published by Stoker Manufacturers Association, 307 N. Michigan Ave., Chicago, Ill. Paper cover; 8½ x 11 in.; 8 pages. Obtainable on request from Stoker Manufacturers' Association, 307 N. Michigan Ave., Chicago, Ill.*]

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The Cause of Cancer

It is the theory of the author of this book that cancer is caused by the action of poisonous organic products released by the combustion of carbonaceous materials such as bituminous coal and petroleum. The heating engineer should be interested in this theory because if it is proved true it would result in many changes in the practice of heating.

The theory cannot be lightly dismissed for the author

is a well known and experienced fuel technologist and organic chemist and has apparently spent many years gathering his evidence. However, it must be remembered that the case presented is at present based upon a theory which has not been proved.

According to the theory the primary cause of cancer in human beings is the exposure to complex hydrocarbons over long periods of time. These hydrocarbons are formed by the high temperature carbonization (over 1472F) of carbonaceous materials such as bituminous coal and petroleum. Products of such carbonization such as manufactured gas and coal tar pitch is also stated to be highly cancer-forming.

To support his theory he presents a large amount of evidence. For example, he brings out the fact that three known causes of a small percentage of the total cases of cancer are: (1) soot; (2) coal tar and its products; (3) a small proportion of lubricating oil from petroleum, together with shale oil. Coal tar, for example, has long been used in research work to cause cancer in mice by painting on the desired spot. The author also brings out the fact that countries using these products have many more reported cases of cancer in proportion to the population than do those countries which use only small amounts of bituminous coal and its products, such as manufactured gas and coal tar pitch.

To reduce the exposure to these products the author proposes that all buildings be heated by electricity or steam or hot water supplied from central stations.

The book is divided into 16 chapters, the first containing an introduction and summary of the book, while the second deals with a definition of cancer. The next six chapters take up present and past theories of the cause of cancer. These are followed by chapters dealing with manufactured gas, coal tar and coal tar products. The fifteenth chapter takes up proper methods of heating, cooling, and lighting, while the last presents the author's conclusions.

[*"The Cause of Cancer," by David Brownlie. Published by Chapman and Hall Ltd., 11 Henrietta St., W. C. 2, England. Cloth cover; 5½ x 7½ in.; 208 pages; price, 7s. 6d., approximately $1.88.*]

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Air Conditioning — Heating and Ventilating

This is the fourth book of a series written to serve as practical treatises on air conditioning. The three previous books deal with ducts, insulation, and furnaces and unit heaters. This one covers the principles and general applications of steam, hot water, vapor, vacuum and forced air for heating, split systems for heating and ventilating, and air conditioning for all types of buildings. A large number of practice problems are given and to increase the value of the text for classroom and individual use manufacturers' tables are included so that practice in equipment selection may be obtained.

[*"Air Conditioning—Heating and Ventilating," by J. Ralph Dalzell and Charles L. Hubbard. Published by the American Technical Society, Drexel Ave., at 58th St., Chicago, Ill. Cloth binding; 8½ x 11 in.; 571 pages; price, $4.*]

BRIEF REVIEWS

CONSTRUCTION STATISTICS. A statistical account of the volume of construction activity in the United States from 1915 to 1937. Includes a definition of the scope of construction, the development of logical classifications of construction activity, a general summary of the statistics, and a brief discussion of the characteristics of the industry. Also includes explanation of the methods which have been used in arriving at the estimates. [*"Construction Activity in the United States—1915-1937." Prepared under the direction of Lowell J. Chawner, Bureau of Foreign and Domestic Commerce, U. S. Department of Commerce. Paper cover, 6 x 9 in., 93 pages. Price, 15 cents. For sale by the Superintendent of Documents, Washington, D. C.*]

COAL. A reprint of the papers presented at the short course in coal utilization held at the University of Illinois, May 25 to 27, 1937. The purpose of this short course was to present an educational program of technical and practical information pertaining to coal and its efficient utilization for the benefit of those engaged in mining, preparing, marketing and using coal. Among the papers of interest to the heating engineer are the following: Domestic Heating Plants; Handling the Common Heating Complaint; Stoker Installation and Servicing; Application of Special Control Systems; Smoke, Dust, and Air Pollution; Eliminating Smoke with a New Device; Portable Instruments for Test Purposes; and Dustless Treatment of Coal. [*"Papers Presented at the Short Course in Coal Utilization," Circular No. 31. Published by University of Illinois, Engineering Experiment Station, Urbana, Ill. Paper cover; 6 x 9 in.; 200 pages; price, 50 cents.*]

FANS. A second edition of this publication. While the subjects covered are the same as those offered in the first edition, the material has been rearranged and comparison charts enlarged. [*"Standard Methods Adopted for Centrifugal Fans and Blowers," NAFM Form X-12. Published by the National Association of Fan Manufacturers, 5-208 General Motors Bldg., Detroit, Mich. Paper cover, 8½ x 11 in., 12 pages.*]

AUTOMATIC HEATING. A paper presented at the 22nd Fuel Engineering Conference sponsored by Appalachian Coals, Inc., February 8, 1938, on automatic heating with bituminous coal. Describes the rapid increase in the use of stokers for the firing of bituminous coal, discusses the combustion in hand-fired and underfeed stoker fired furnaces and gives information on the proper size of stoker coal, adjustment of air supply, relation of air setting to coke trees, how to find correct air damper setting, control of air in off periods, control of hold-fire operation, clinker formation, efficiency of residential installations, and relative costs of various forms of automatic heating in Atlanta. [*"Automatic Residential Heating with Bituminous Coal," by R. A. Sherman. Published by Appalachian Coals, Inc., Cincinnati, Ohio. Paper cover; 8½ x 11 inches; mimeographed; 20 pages.*]

DUST. The results of a survey to determine the degree of severity of the dust hazard in the foundry industry in New York State. As a result of the investigation, Doctor Greenburg stressed that while there was some silicosis in the foundry industry, the incidence was such as to show the foundry to be a borderline industry. Doctor Greenburg stated that dust hazard is a condition that can be rectified by the application of common sense engineering principles. [*"Silicosis in the Foundry Industry," Reprint No. 38-35, by Dr. Leonard Greenburg. Published by the Safety and Hygiene Section, American Foundrymen's Association, Inc., 222 W. Adams St., Chicago, Ill. Paper cover, 6 x 9 in., 36 pages.*]

DUST SAMPLING. Describes the konimeter which is a dust sampling instrument that collects the dust from a small volume of air by impingement on a glass plate prepared with an adhesive film. Also gives information on the preparation for use, collection of dust samples, counting samples, and calculation of dust concentration. [*"Technique for Routine Use of the Konimeter," by J. B. Littlefield, C. E. Brown and H. H. Schrenk. Information circular 6993, Bureau of Mines, Washington, D. C. Paper cover; 8½ x 11 in.; 6 pages; free. Obtainable from Section of Publications, Bureau of Mines, Washington, D. C.*]

HEAT TRANSFER. The results of a series of experiments with water and several grades of oil being cooled in a shell-and-tube heat exchanger. Information is presented in a graphical and analytical manner. The heat exchanger was first used without baffles or turbulence promoters, and then with half-moon type, then orifice type, and finally disk-and-doughnut type baffles. Both the heat transfer coefficients for the outside of the tubes in the bundles and the pressure drop on this same side are treated. [*"Heat Transfer and Pressure Drop in Heat Exchangers," by Byron E. Short, Bureau of Engineering Research, College of Engineering, the University of Texas, Austin, Texas. Publication No. 3819. Paper cover, 6 x 9 in., 39 pages.*]

HOUSING. A report which systematically considers those elements of healthfulness which must be provided in the design, construction and management of new housing developments if these enterprises are to be acceptable from the viewpoint of health. The report consists of thirty basic principles with specific requirements and suggested methods of attainment for each. The principles and specific requirements are believed to be fundamental minima required for the promotion of physical, mental and social health, essential in low cost as well as high cost housing on the farm as well as in the city tenement. Under the methods of attainment are suggested the more important means by which these objectives can be achieved. [*"Basic Principles of Healthful Housing," a preliminary report of the Committee on the Hygiene of Housing. American Public Health Association, 50 W. 50th St., New York, N. Y. Paper cover; 6 x 9 in.; 21 pages; price, 25 cents.*]

ELEMENTARY THERMODYNAMICS. A text book for short courses in thermodynamics. The book differs from more complete texts only in that it presents fewer topics for consideration and not in shortened discussions. Among the subjects covered are the following: general energy equation; characteristic equation of a perfect gas; energy equations of a perfect gas; reversible non-flow processes of gases; Carnot and Ericsson cycles; compression and expansion of air; liquids and vapors; processes of vapors; vapor cycles; refrigeration; flow in nozzles and mixtures. [*"Elementary Thermodynamics," by V. M. Faires. Published by The Macmillan Co., New York. Cloth cover, 6 x 9 in., 225 pages, price, $2.60.*]

APPLIED THERMODYNAMICS. Covers in elementary fashion the theories and thermodynamics involved in engineering problems. To add interest there are occasional short biographical sketches of scientists and engineers who have been prominent in the development and application of thermodynamics. A number of photographic illustrations have been included to give light and substance to otherwise abstract theory. For the convenience of the student and instructor, problems are incorporated in a separate problem book. This book contains approximately 1200 problems, as well as tables and charts of the properties of fluids. Some of the chapter headings of interest to heating and air conditioning engineers are: Compression and Expansion of Air; Air Refrigeration; Mixtures of Gases; Combustion and the Products of Combustion; Liquids and Vapors; Flow of Steam in Nozzles; Vapor Refrigeration; Mixtures of Vapors and Gases; and the Transfer of Heat. [*"Applied Thermodynamics," by V. M. Faires. Published by The Macmillan Co., New York. Cloth cover, 6 x 9 in., 374 pages, price, $3.90. "Problems on Applied Thermodynamics," by V. M. Faires and A. Brewer. Published by The Macmillan Co., New York. Paper cover, 6 x 9 in., 138 pages, price, $1.40.*]

AIR CONDITIONING. Two spirally bound booklets designed to promote residential and commercial air conditioning in St. Louis. Booklets are made up principally of illustrations of air conditioned buildings. [*"Air Conditioning in St. Louis and Vicinity." Published by Air Conditioning Bureau of St. Louis in cooperation with the Union Electric Co., St. Louis, Mo. Paper cover, 8½ x 11 in.*]

WELDING ELECTRODES. Standards for welding electrodes which have recently been adopted by the Electric Welding Section of the National Electrical Manufacturers Association. The principal functions of these standards are: (1) To define the various classes of metallic electrodes used in arc welding; and (2) to standardize the packaging, diameters, and lengths of the various types of electrodes. [*"NEMA Standards for Welding Electrodes," September 15, 1937. Published by National Electrical Manufacturers Association, 155 E. 44th St., New York. Four mimeographed, standard-size pages; obtainable from the above address.*]

DUST SAMPLING. Describes a new hand-operated pump to operate the midget impinger dust-sampling apparatus developed by the Bureau of Mines, its operation and compares the results obtained with the midget impinger and the regular impinger. [*"Dust Sampling with the Bureau of Mines Midget Impinger, Using a New Hand-Operated Pump," by J. B. Littlefield and H. H. Schrenk. Report of Investigations 3387. Bureau of Mines, Washington, D. C. Paper cover; 8½ x 11 in.; 4 pages; free. Obtainable from Section of Publications, Bureau of Mines, Washington, D. C.*]

COKE. The results of a study of distribution of byproduct and beehive coke produced in the United States during 1936. This study continues the summary table of coke consumed, by states and uses, and the tabulation of the source and quantity of byproduct and beehive coke consumed in each state grouped into regions, also according to uses. In addition, it introduces a new section showing the destination of coke produced in 1936, by states of origin and by uses. These three groups of tables indicate the approximate size and nature of the market for coke in a given state, as well as the principal sources of coke and the respective consuming areas they customarily supply. Changing trends in the utilization of coke are also discussed. [*"Distribution of Byproduct and Beehive Coke in 1936," by M. van Sicklen and H. L. Bennit, Coal Economics Div., Bureau of Mines, U. S. Department of Interior, Washington, D. C. Paper cover, mimeographed, 8 x 12½ in., 26 pages.*]

SILICOSIS. Suggests methods for overcoming the formation of dusts in industry and for minimizing the effects of breathing industrial dusts. [*"Methods for Protection Against Silicosis and When They Are Justified," by D. Harrington. Information circular 6989. Bureau of Mines, Washington, D. C. Paper cover; 8½ x 11 in.; 9 pages; free. Obtainable from Section of Publications, Bureau of Mines, Washington, D. C.*]

SILICOSIS. Gives results of research on this subject by the Bureau of Mines and other agencies, as well as industry, and forecasts some of the things that may be done to reduce the prevalence of dust diseases in the future. [*"Some of the Results of Recent Research on the Control or Prevention of Silicosis," by D. Harrington. Information circular 6994. Bureau of Mines, Washington, D. C. Paper cover 8½ x 11 inches; 8 pages; free. Obtainable from the Section of Publications, Bureau of Mines, Washington, D. C.*]

SMOKE. A progress report of the studies made over a number of years by a Pittsburgh group in an effort to find the relation between the local smoky atmosphere and the high death rate from pneumonia. [*"Necropsy Evidences on the Relation of Smoky Atmosphere to Pneumonia," by S. R. Haythorn and Harry B. Meller. Published in the American Journal of Public Health, 50 W. 50th St., New York, Pages 479 to 486, April, 1938.*]

DUST CONTROL. A review of the foundry dust problem and a brief presentation of some of the measures that have been developed for its control. [*"Outline of Measures for Dust Control in Foundries of State," by Theodore Hatch. Published in "The Industrial Bulletin," State Office Building, Albany, N. Y. Pages 114 to 118, April, 1938.*]

HEAT TRANSMISSION. Formulae, tables and curve sheets showing heat loss from pipes and surfaces in both still air and air moving at various velocities. Data are valuable for establishing losses for uninsulated hot surfaces; also for use in heat transmission formulae where the rate of heat transmission from the surface is an important factor in determining the overall heat transmission through the structure. [*"Heat Transmission from Surfaces," Bulletin 102-A. Published by the Philip Carey Co., Cincinnati, Ohio. Paper cover, 8½ x 11 in., 12 pages. Available at the above address on request.*]

AIR CONDITIONING. A review of the principles of air conditioning, including information on the history, development, factors affecting comfort, refrigeration, drying, dehumidifying and temperature and humidity control. Included is a large size Bulkeley psychrometric chart. This paper was presented before the Institution of Heating and Ventilating Engineers, London, January 5, 1938. [*"Air Conditioning Factors," by Thomas Chester. Paper cover; 7 x 9½ in.; 44 pages. Copies obtainable from Davidson & Co., Ltd., Central House, 45 Kingsway, London, W. C. 2, England; price, $1.*]

ORGANIC VAPOR DETERMINATION. Describes a method of estimating the concentration of vapors in the air, especially those of organic solvents, by adsorption. [*"Determination of Organic Vapors Using the Method of Adsorption," by S. Moskowitz and W. J. Burke. Published in "The Industrial Bulletin," State Office Building, Albany, N. Y. Pages 168 to 169, April, 1938.*]

STEAM JET COOLING. A new section of standards of the Heat Exchange Institute on steam jet ejector and vacuum cooling. Part 1, on steam jet ejectors, covers nomenclature, operating principles, construction, capacity and standard auxiliaries and materials of construction. Part 2, on test codes for steam jet ejectors, covers motive steam, condensing water, vacuum and pressure measurement, performance tests, diagrammatic arrangements of apparatus for conducting various tests, standard air nozzle orifices and curves on steam flow and air water vapor mixture data. Part 3, on steam jet vacuum refrigeration equipment, covers nomenclature, definitions, performance, construction, standard units and special types. [*"Standards of Heat Exchange Institute —Steam Jet Ejector and Vacuum Cooling Section." Published by the Heat Exchange Institute, 90 West St., New York. Paper cover; 8½ x 11 in.; 40 pages; price, $1.*]

PROPERTIES OF SATURATED F12

Temp.	Pressure		Volume		Heat Content		Entropy	
	Lb. per Sq. In.		Cu. Ft. per Lb.		B.t.u. per Lb. Above −40F			
Deg. F	Abs.	Gauge	Liquid	Vapor	Liquid	Total or Vapor	Liquid	Total or Vapor
1	2	3	4	5	6	7	8	9
0	13.87	9.2	0.0110	1.637	8.25	78.21	0.01869	0.17091
2	14.39	10.2	0.0110	1.574	8.67	78.44	0.01961	0.17075
4	15.46	11.3	0.0111	1.514	9.10	78.67	0.02052	0.17060
6	16.57	11.8	0.0111	1.456	9.52	78.78	0.02097	0.17052
8	17.05	12.3	0.0111	1.457	9.53	78.90	0.02143	0.17045
9	18.19	13.5	0.0111	1.403	9.96	79.13	0.02235	0.17030
10	19.35	14.6	0.0112	1.351	10.39	79.36	0.02328	0.17015
12	20.56	15.9	0.0112	1.301	10.81	79.59	0.02419	0.17001
14	21.80	17.1	0.0112	1.253	11.26	79.81	0.02510	0.16987
16	23.08	18.4	0.0112	1.207	11.70	80.05	0.02601	0.16974
18	24.40	19.7	0.0113	1.163	12.12	80.27	0.02692	0.16961
20	25.75	21.1	0.0113	1.121	12.55	80.49	0.02783	0.16949
22	27.15	22.5	0.0113	1.081	13.00	80.72	0.02873	0.16938
24	28.58	23.9	0.0113	1.043	13.44	80.95	0.02963	0.16926
26	30.07	25.4	0.0114	1.007	13.88	81.17	0.03053	0.16913
28	31.59	26.9	0.0114	0.973	14.32	81.39	0.03143	0.16900
30	33.16	28.5	0.0115	0.939	14.76	81.61	0.03233	0.16887
32	34.77	30.1	0.0115	0.908	15.21	81.83	0.03323	0.16876
34	36.42	31.7	0.0115	0.877	15.65	82.05	0.03413	0.16865
36	38.13	33.4	0.0116	0.848	16.10	82.27	0.03502	0.16854
38	39.88	35.2	0.0116	0.819	16.55	82.49	0.03591	0.16843
39	40.78	36.1	0.0116	0.806	16.77	82.60	0.03635	0.16838
40	41.68	37.0	0.0116	0.792	17.00	82.71	0.03680	0.16833
41	42.70	38.0	0.0116	0.779	17.23	82.82	0.03725	0.16828
42	43.51	38.8	0.0116	0.767	17.46	82.93	0.03770	0.16823
44	45.40	40.7	0.0117	0.742	17.91	83.15	0.03859	0.16813
46	47.35	42.7	0.0117	0.718	18.36	83.36	0.03948	0.16803
48	49.35	44.7	0.0117	0.695	18.82	83.57	0.04037	0.16794
50	51.39	46.7	0.0118	0.673	19.27	83.78	0.04126	0.16785
52	53.49	48.8	0.0118	0.652	19.73	83.99	0.04215	0.16776
54	55.63	50.9	0.0118	0.632	20.18	84.20	0.04304	0.16767
56	57.84	53.1	0.0119	0.612	20.64	84.41	0.04392	0.16758
58	60.10	55.4	0.0119	0.593	21.11	84.62	0.04480	0.16749
60	62.41	57.7	0.0119	0.575	21.57	84.82	0.04568	0.16741
62	64.77	60.1	0.0120	0.557	22.03	85.02	0.04657	0.16733
64	67.20	62.5	0.0120	0.540	22.49	85.22	0.04745	0.16725
66	69.67	65.0	0.0120	0.524	22.95	85.42	0.04833	0.16717
68	72.24	67.5	0.0121	0.508	23.42	85.62	0.04921	0.16709
70	74.82	70.1	0.0121	0.493	23.90	85.82	0.05009	0.16701
72	77.50	72.8	0.0121	0.479	24.37	86.02	0.05097	0.16693
74	80.20	75.5	0.0122	0.464	24.84	86.22	0.05185	0.16685
76	83.00	78.3	0.0122	0.451	25.32	86.42	0.05272	0.16677
78	85.85	81.2	0.0123	0.438	25.80	86.61	0.05359	0.16669
80	88.76	84.1	0.0123	0.425	26.28	86.80	0.05446	0.16662
82	101.70	87.0	0.0123	0.413	26.76	86.99	0.05534	0.16655
84	104.8	90.1	0.0124	0.401	27.24	87.18	0.05621	0.16648
86	107.9	93.2	0.0124	0.389	27.72	87.37	0.05708	0.16640
88	111.1	96.4	0.0124	0.378	28.21	87.56	0.05795	0.16632
90	114.3	99.6	0.0125	0.368	28.70	87.74	0.05882	0.16624
92	117.7	103.0	0.0125	0.357	29.19	87.92	0.05969	0.16616
94	121.0	106.3	0.0126	0.347	29.68	88.10	0.06056	0.16608
96	124.5	109.8	0.0126	0.338	30.18	88.28	0.06143	0.16600
98	128.0	113.3	0.0126	0.328	30.67	88.45	0.06230	0.16592
100	131.6	116.9	0.0127	0.319	31.16	88.62	0.06316	0.16584
102	135.3	120.6	0.0127	0.310	31.65	88.79	0.06403	0.16576
104	139.0	124.3	0.0128	0.302	32.15	88.95	0.06490	0.16568
106	142.8	128.1	0.0128	0.293	32.65	89.11	0.06577	0.16560
108	146.8	132.1	0.0129	0.285	33.15	89.27	0.06663	0.16551
110	150.7	136.0	0.0129	0.277	33.65	89.43	0.06749	0.16542
112	154.8	140.1	0.0130	0.269	34.15	89.58	0.06836	0.16533
114	158.9	144.2	0.0130	0.262	34.65	89.73	0.06922	0.16524
116	163.1	148.4	0.0131	0.254	35.15	89.87	0.07008	0.16515
118	167.4	152.7	0.0131	0.247	35.65	90.01	0.07094	0.16505
120	171.8	157.1	0.0132	0.240	36.16	90.15	0.07180	0.16495
122	176.2	161.5	0.0132	0.233	36.66	90.28	0.07266	0.16484
124	180.8	166.1	0.0133	0.227	37.16	90.40	0.07352	0.16473
126	185.4	170.7	0.0133	0.220	37.67	90.52	0.07437	0.16462
128	190.1	175.4	0.0134	0.214	38.18	90.64	0.07522	0.16450
130	194.9	180.2	0.0134	0.208	38.69	90.76	0.07607	0.16438
132	199.8	185.1	0.0135	0.202	39.19	90.86	0.07691	0.16425
134	204.8	190.1	0.0135	0.196	39.70	90.96	0.07775	0.16411
136	209.9	195.2	0.0136	0.191	40.21	91.06	0.07858	0.16396
138	215.0	200.3	0.0137	0.185	40.72	91.15	0.07941	0.16380
140	220.2	205.5	0.0138	0.180	41.24	91.24	0.08024	0.16363

PROPERTIES OF SUPERHEATED F12 VAPOR

Saturated Vapor		Superheated Vapor					
		Volume Cu. Ft. per Lb.	Heat B.t.u. per Lb.	Entropy B.t.u. per Lb.	Volume Cu. Ft. per Lb.	Heat B.t.u. per Lb.	Entropy B.t.u. per Lb.
Temp.	Press.	10F or Superheat			20F or Superheat		
1	2	3	4	5	6	7	8
0	13.87	1.676	79.60	0.17286	1.717	81.00	0.17600
10	19.35	1.382	80.78	0.17508	1.418	82.18	0.17822
20	25.75	1.150	81.91	0.17721	1.178	83.48	0.18035
30	33.16	0.9614	83.06	0.17177	0.9862	84.52	0.18247
40	51.68	0.8133	84.18	0.17121	0.8340	85.66	0.18460
50	61.39	0.6923	85.27	0.17913	0.7097	86.76	0.18561
		30F or Superheat			40F or Superheat		
0	13.87	1.741	81.71	0.17819	1.838	83.26	0.18097
10	19.35	1.434	82.90	0.17747	1.516	84.31	0.18309
20	25.75	1.192	84.09	0.17679	1.260	85.60	0.18522
30	33.16	0.9986	85.25	0.17612	1.056	86.87	0.18735
40	51.68	0.8443	86.41	0.17554	0.8928	90.10	0.18948
50	61.39	0.7185	87.54	0.17505	0.7620	91.28	0.19060
Heat Content and Entropy are above values at −40F							

DICHLORODIFLUOROMETHANE (CCl_2F_2)

Boiling Point, minus 21.7F Freezing Point, minus 247F	Critical Temperature, 233F Critical Pressure, 582 lb. per sq. in.

Approximate Specific Heats (Over Ranges of Temps)

Liquid, from 0.206 to 0.233; Vapor at constant pressure = C_p = 0.14; and Vapor at constant volume = C_v = 0.124, for C_p/C_v = 1.13

Properties at Common Rating Points

(Without Liquid Sub-Cooling and Without Superheat in Suction, Dry Compression)	Refrig.	Air Cond.
	At 5F Suction	At 40F Suction
	And 86F Condensing Temperature	
Cooling coil (low side) pressure, (lb., abs)	26.51	51.68
Condenser (high side) pressure, (lb., abs)	107.9	107.9
Heat in suction vapor, B.t.u. per lb., (column 7)	78.79	84.31
Heat in liquid before exp. valve, per lb., (column 6 at 86F)	27.72	27.72
Refrigerating effect,[1] (B.t.u. per lb. of refrigerant)	51.07	56.59
Theoretical work of compression,[2] (B.t.u. per lb.)	10.85	9.91
Volume of suction vapor, cu. ft. per lb., (column 5)	1.983	0.890
Theor. lb. of refrigerant, per ton, per min.[3]	3.90	3.54
Theor. piston displ., per ton, per min., (cu. ft.)[4]	7.81	3.20
Horsepower per ton[5]	0.997	0.937
Coefficient of performance, cycle	4.72	5.69
Coefficient of performance, carnot	5.74	10.87

[1]Equals difference between two preceding figures.
[2]By computation, from equating enthalpies.
[3]Equals 200 ÷ refrigerating effect.
[4]Product of two preceding figures.
[5]By calculation.

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REFRIGERANTS FOR AIR CONDITIONING—DICHLORODIFLUOROMETHANE (F

The data in the several tables of this sheet present in a compact form the commonly desired properties of the refrigerant F12. Values as tabulated are based on the only known work on the subject which was published as Circular No. 12 of the ASRE in 1931 entitled "Thermodynamic Properties of Dichlorodifluoromethane" and the properties of this refrigerant are usually taken from this source. Consequently there is little or no variation in the published properties as found in the various text and reference books.

The variation in the values of specific heats of the liquid over the range in the tables is indicated. The ratio of C_p to C_v is commonly stated to be 1.13 and this is the value stated in these tables.

The saturated table extends over the usual range for air conditioning and much commercial refrigeration work. Both gage and absolute pressure are listed for convenience, with the atmospheric pressure considered steady at 14.7 lb. per sq. in. Volumes of both liquid and vapor are given instead of densities, but the density can be found as the reciprocal of the unit volume when this figure is needed. Entropies are included because of their usefulness in analyzing possible performances.

The superheat table is purposely limited to superheats in the region of the temperature and pressure of the suction vapor, and at the temperatures commonly associated with air conditioning and commercial refrigeration work. Superheat properties over the whole range require more space for tabulation than the frequency of their use seems to justify here.

The various properties tabulated at the common rating points for air conditioning and refrigeration purposes are especially valuable when comparing the characteristics of refrigerants. Many of these figures are also applicable for estimating purposes.

The table giving suitable pipe sizes for use with F12 when the cooling load is known, is believed to be amply safe for most air conditioning and refrigeration purposes since the sizes are based on small velocities and low unit pressure drops in the piping.

PIPE SIZES FOR F12

Nominal Pipe Size In Inches	Vapor Suction Lines		Liquid Lines	
	Cooling Load In B.T.U. per Hour			Lb. of F12 per 100 Lin. Ft.
	Refrig. (5F)[1]	Air Cond. (40F)[2]		
⅜			6,000	
½	400	600	18,000	3
⅝	3,600	4,800	36,000	6
¾	6,000	9,600	60,000	11
⅞	12,000	20,000	120,000	24
1	24,000	36,000	216,000	43
1¼	36,000	55,000	336,000	69
1½	54,000	80,000	480,000	97
2	96,000	138,000	840,000	172
2½	132,000	200,000	1,344,000	256
3	216,000	312,000		
3½	288,000	420,000		
4	372,000	540,000		
5	530,000	800,000		
6	870,000	1,250,000		
Max. Velocity f.p.m.	2200	1600	150	
1	2	3	4	5

[1] If suction temp. is under 25F use column headed (5F).
[2] If suction temp. is over 25F use column headed (40F).

NOTE:—Lines ⅜ in. and Less:—Under 25 lin. ft. as tabulated; 26 to 75 lin. ft. use one size larger; 76 to 150 lin. ft. use two sizes larger.
Lines 1 in. to 2 in., Inclusive:—Under 50 lin. ft. as tabulated; 51 to 100 lin. ft. use one size larger; 101 to 200 lin. ft. use two sizes larger.
Lines 2½ in. and Over:—Under 100 lin. ft. as tabulated; 101 to 200 lin. ft. use one size larger; 201 to 300 lin. ft. use two sizes larger.

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Best Air Conditions for Hatching Chicks

OVER 1,100,000,000 chicks are hatched annually in this country and to produce this number 1,800,000,000 eggs of average hatchability are required. The failure of 700,000,000 eggs to hatch represents an annual loss of $14,000,000.

Of paramount importance in egg hatching are the temperature, humidity, and analysis of the atmosphere surrounding the eggs. It is known now that long before lungs begin to develop in the chick embryo there is respiration, with oxygen entering and carbon dioxide leaving the porous shell.

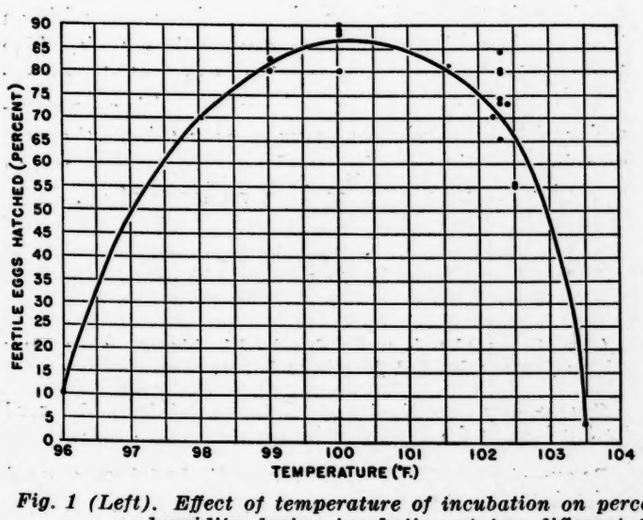
Studies were recently reported by the Department of Agriculture made to arrive at the best temperature and humidity of the air surrounding eggs, and of the best percentage of carbon dioxide and oxygen in the air in order to get the highest possible percentage of normal chicks from eggs being hatched.

Effect of Temperature

Tests on incubation, with other variables constant, were conducted at temperatures from 96 to 103.5F. The relative humidity was kept at 60%, the oxygen concentration at 21%, and the carbon dioxide below 0.5%. The air movement was about five inches per minute.

The results are shown in Fig. 1. The best hatches were obtained at 100F, indicating that this is the optimum temperature for incubation. The percentage of eggs hatched decreased as the temperature fell below or rose above 100F, until at 96 and 103.5F nearly all the embryos died in the shell.

Not only was the hatch percentage higher at 100F but the appearance of the chicks was better than at other temperatures. At 103F, for example, the chicks were not so large, fluffy or lively as those hatched at 100F, and there were many abnormalities at 102F, such as crooked necks and toes. At 100F there were no crooked necks and few crooked toes.



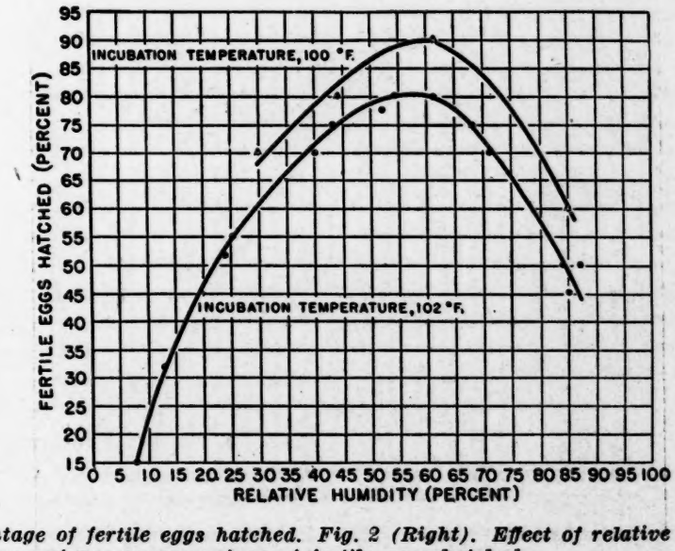


Fig. 1 (Left). Effect of temperature of incubation on percentage of fertile eggs hatched. Fig. 2 (Right). Effect of relative humidity during incubation at two different temperatures on percentage of fertile eggs hatched.

Effect of Humidity

Two series of tests were run on the effect of relative humidity, one with varying relative humidities, a temperature of 102F, oxygen at 21%, carbon dioxide below 0.5% and air movement 5 in. per min.; the other with varying relative humidities, a temperature of 100F, with other variables as before. The results are shown in Fig. 2.

The best hatches were obtained at 58% relative humidity at 102F and 61% at 100F, or when the absolute humidity was the same. The best results were with 100F temperature and 61% R.H. Fairly good hatches may be expected with humidities from 40 to 70%.

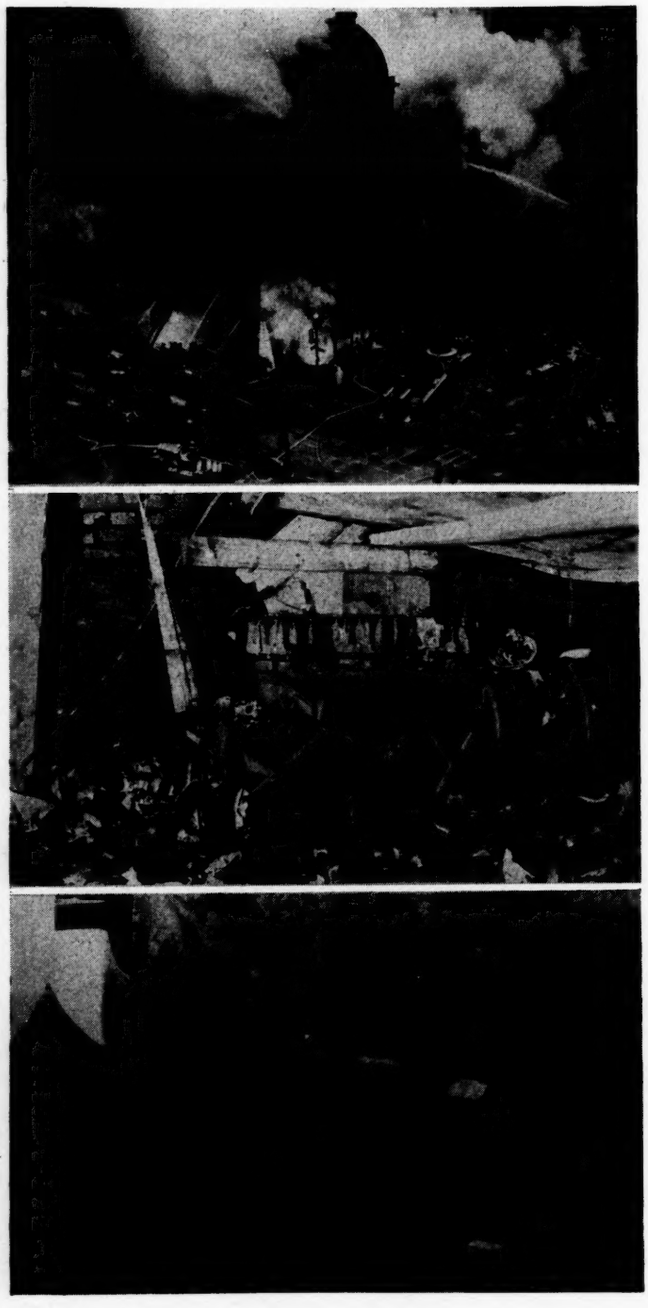
Effects of Carbon Dioxide and Oxygen

In general, the investigators concluded that the best results were obtained with carbon dioxide below 0.5% and with oxygen at 21%.

Summary

The best air conditions for hatching chicks, from the standpoint of incubation and growth of the chick embryo, are: temperature, 100F; relative humidity, 61%; oxygen, 21%; carbon dioxide, below 0.5%. The temperature should not vary more than half a degree from 100F. The relative humidity may vary 10%. The oxygen should not drop below 21%, and the carbon dioxide should not be greater than 1%.

H. G. Barott, poultry technologist of the animal husbandry division of the Bureau of Animal Industry, Department of Agriculture, supervised the work and reported the results.



Compressor-Condensing Unit Withstands Severe Fire

MAN-MADE machinery's ability to "take it" was dramatically demonstrated recently when an air conditioning compressor unit withstood the intense heat of a ravaging fire, and yet was put in operating condition simply by cleaning it and reconnecting it to the proper lines.

Recently hundreds of firemen battled for more than three hours to control a fire in the William Hahn & Company shoe store in Washington, D. C.

In the basement of the store was a 25-hp. condensing unit. Part of a crumbled wall had fallen on it, shearing off power and water supply connections. The main floor had collapsed showering the unit with scorching embers and heavy beams. Tons of water, poured into the inferno from firemen's hose lines, had nearly submerged it.

An examination revealed that the only action necessary to put the unit back in operating condition was to clean it thoroughly on the exterior parts with an iron brush, and connect new copper lines to it. The heat of the fire was so great that it melted the copper tubing running to and from the unit. With a good exterior cleaning and some new copper tubing the unit was in operating condition. It was not necessary to rewind the motor, or to make a rechange of oil.

Top—Scene showing the fire in Washington shoe store where firemen battled for three hours.

Center—Air conditioning unit at scene of fire undamaged by the heat and falling debris.

Below—Air conditioning unit after it had been cleaned and set up for reconnection.

Photos courtesy Westinghouse.

Air Conditioning Fruit Cars with Diesels

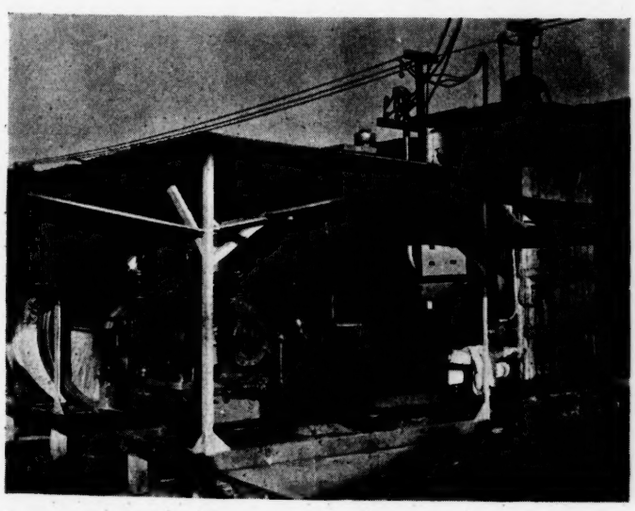
FEW people realize that fruit, vegetable and meat-carrying freight cars were users of air conditioning long before the first passenger car. Refrigerated cars for perishable goods have been in service for over a third of a century—and a crude form of air conditioning was what made possible the movement of perishables over long distances.

From the very beginning ice has been the mainstay for precooling cars as well as for maintaining low temperatures in transit. Many experimental cars have been built with small refrigerating plants housed in one end of the car—but ice still stands as the accepted method of maintaining a cool temperature during movement.

Probably few persons, except those in the produce, meat packing or railroad industry, realize that equally as important as maintaining a low temperature during transit is the problem of precooling the car *before* it is started on its journey.

It is this problem of precooling that has been the subject of considerable research during recent years, and from this research and experimenting has now come a new method that may revolutionize previous systems of car precooling. One individual who is due credit for thoroughly studying this problem, and then doing something about it, is Harry Y. Stebbins, vice-president of the General American Precooling Corporation. It was over three years ago that there was put into service a mechanical precooling plant, built from his designs.

These early precoolers were designed to shorten the time required to remove the field heat from a car that might have been standing on a siding under a blistering sun for a few hours or a week. Ordinarily ice would be loaded into the car and from 24 to 48 hours would be needed to lower the car's temperature to a point where loading could be safely accomplished. The plant designed by Stebbins consisted of an electrically-driven refrigeration compressor plant mounted on an ordinary truck type of trailer. The trailer would be spotted beside the open doors of the car to be cooled, and the plant started up. This system tremendously reduced the time required in precooling—and was superior to the old methods of icing a car.



Typical setup of compressor with one of the six cooling structures shown precooling a car.

After the car was loaded with fruit, the trailer carrying the refrigerating plant would again be brought alongside. Additional cooling would be given the loaded car until the correct temperature was reached.

It was in late 1936 that the first diesel-powered plant was built. Since then a number have been put in service and a production program is now being started. Essentially all of the diesel units to date are the same. On a welded structural steel base, about the size of an average truck trailer, is mounted the entire self-contained refrigeration equipment consisting of the Cummins diesel, compressor, condenser, brine tanks and circulating pumps.

These engines are of the full diesel, cold starting type, equipped with a 24-volt electric starting system. On the front of the engine is a short shaft on which two V-belt pulleys are mounted. The belt going downward drives the 500 g.p.m. brine circulating pump, while the upper belt drives a line shaft used to operate an air circulating fan. (The fan is installed only when the plant is to be operated in a cold storage warehouse and is not needed for produce car precooling.) The compressor is belt-driven through the clutch power take-off of the diesel.

The diesel is set for 1200 r.p.m., which gives a speed of 325 r.p.m. on the compressor. A line shaft extends from the shaft that carries the compressor driving pulley and on this line shaft are the circulating fans located in each end of a high velocity condenser. This same shaft drives the 200 g.p.m. condenser pump through chain and sprockets.

When in service this unit is transported to the railroad siding where the cars are to be loaded. The balance of the equipment needed consists of six small structures in which are located the heat exchange equipment and their electrically-driven air circulating fans.

All six cooling-structures are piped in series, and in this manner six produce cars can be cooled at one time, from the single compressor plant. Canvas shrouds that completely enclose the car doors extend from the cooling-structures to the sides of the produce cars. These cooling units are so built that the air in the car is drawn through the cooling medium, and returned to the car once every two seconds. The fans in the cooling-structures are driven by a 5-hp. electric motor. At the same time the air is being cooled it is also washed and humidified. In this manner the true and complete fundamentals of air conditioning take place; namely, cooling, circulating, washing, and humidifying.

As an example of the speed with which fruit cars can be cooled is the fact that a car loaded with grapes or plums can be brought down to about 39F in six hours —and strawberries in about two hours. This compares to about 72 hours and 36 hours, respectively, when ice alone is used. Another factor of tremendous importance is that the temperatures on various tiers of fruit, at various places in the cars, and even in the centers of the crates, are fairly uniform.

EDITORIALS

Building Construction's Bad Press

For some time editorials and articles appearing in the newspaper press have sung the theme song that what is wrong with the whole building picture is the high cost of getting a building erected and that new developments would shortly change all this. Just who composed this song and then peddled it to editors and publishers is not known but whoever did so has done a very effective job. As a piece of propaganda it should be rated as highly successful for it has undoubtedly done a great deal to slow up the rate of building construction activity especially in the home-building field. In what other field could activity be sustained if the whole emphasis were on high cost to the purchaser, and if the purchaser were continually reminded that he can expect some startling new developments very shortly? Yet that is exactly the tone taken in the newspaper press in connection with new building construction.

If there were any essence of truth in the situation there is certainly no reason why the press should not speak out about it. Careful attention, however, leads to the conclusion that not only are present building costs fairly low based on comparative standards but that there is no reason to expect anything outstanding soon from the attempts at prefabrication and standardization of building construction.

We have watched the great manufacturing and merchandising organizations nearly all try their hands at prefabrication. Their ten year record is not impressive. It is doubtful if all the research and study put on this whole subject has done anything more than convince most of those who went into it that they might better leave the whole thing to someone else. In some localities and for some restricted purposes something may materialize, but that the whole of building practice is to be changed by the prefabrication idea is becoming more and more doubtful as each proposal runs its short-lived course.

As to the cost of erecting a building now it should be noted that prices of both building materials and building equipment are considerably lower than they were ten years ago. Labor wage rates for skilled building labor are still high—higher than ever before. But it is doubtful if the actual labor cost of erecting a building is as high now as it has been in the past. This is due to better handling of labor, wider use of power tools, and development of equipment and materials which take less labor on the site than ever before. So much a fact is this lowering of cost that it is now seriously argued that a modern air conditioned building need cost no more than did one of like utility but without air conditioning just before the depression year of 1929. Actual examples of this cost situation are now multiplying rapidly.

In spite of all this the "bad press" still continues. What is needed is a seriously undertaken and comprehensive movement to marshal all this scattered evidence into an orderly presentation which can be sold to those in control of the newspapers. It is in a situation of this kind that the lack of unity among the several interests in the great building industry is especially notable. There is no body which can present the case in its true light and do a convincing job without unduly emphasizing some phase while understating others. Indeed, it is quite likely that if such a single body representing the building industry, as the Automobile Chamber of Commerce represents the automotive industry, were in existence and functioning, such misleading information would never have reached the press in the first place.

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Absorption Refrigeration for Air Conditioning

We have on several occasions called attention to the struggle which is going on over how summer air conditioning shall be powered. Heretofore electrical drive has had the whole field pretty much to itself with other power sources, including diesel and gas engines, succeeding in breaking in only in special situations. So little encouragement have these power sources received that their development has been stinted, with but few equipment manufacturers liking the prospects well enough to embark on the research and investigation necessary to bring out their full possibilities.

Now comes word that gas as a competing power source is to receive the wholehearted promotion of some of the important utility companies. This means a sharp change in policy and some material changes in the whole air conditioning power situation will undoubtedly result. It means that there will be less tendency to adopt electric power automatically and that the merits of the possible use of gas will be looked into when a job is under discussion and an installation is being planned.

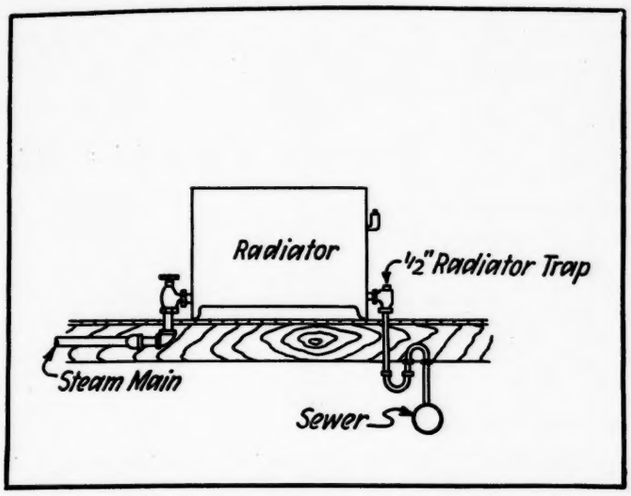
It may also easily mean a much more sympathetic view of the advantages of the absorption cycle of refrigeration than has prevailed among engineers generally in recent years. We predict that the absorption cycle is going to loom large in technical interest in the next few years and that even now it is time to be giving thought and attention to it if you want to keep abreast of refrigeration practice in air conditioning. Once the cycle does begin to command more attention it will be found to have many interesting side lights including the possible use of the same fuel for air heating as for air cooling.

KINKS

Sewer Serves as Temporary Radiator Drain

A radiator on the end of a one-pipe steam system was troubled with slow heating and water hammer. The system was supplied with steam at 5 lb. pressure from a central heating plant.

Upon examining the system it was found that the trouble was caused by the small pipe which connected the radiator with the main. Since conditions made it



impossible to increase the size of the pipe it was decided to install an additional pipe to the return main. Until this could be done a temporary connection was made to drain the condensate to the sewer.

A ½-in. thermostatic radiator trap was installed on the radiator as shown in the sketch. The drain to the sewer was made through an "S" trap to prevent the sewer gases from backing up into the radiator when the radiator was shut off or when the system was not operating. Loss of condensate by this method was not considered serious as the connection was only temporary.—*William Smith, Hoboken, N. J.*

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Liberal payment will be made for brief articles which are, in the opinion of the editors, useful and generally applicable kinks relating to drafting room, shop, plant, or field practice in the design, installation, operation, or maintenance of heating, ventilating, or air conditioning equipment. Sketches (in pencil) or photos should be included when necessary.

●

THE MONTHLY QUIZ

How many of the following teasers can you answer offhand? Only one of the answers given after each question is correct. Check your answers against those appearing on page 63

1. The ratio of the partial pressure of water vapor in the air to the saturation pressure at the dry bulb temperature is (1) the gas constant (2) specific humidity (3) absolute humidity (4) relative humidity (5) ratio of latent heat to total heat.

2. Threads on pipe and fittings generally used in heating work are (1) Whitworth screw threads for hydraulic piping (2) American Briggs standard pipe thread (3) U. S. Standard screw thread (4) International standard thread (5) Acme standard thread.

3. A propeller fan is (1) of the centrifugal type (2) of the radial flow type (3) of the backward curved blade type (4) of the axial type (5) of the forward curved blade type.

4. A Hartford loop is (1) a device for absorbing expansion in piping (2) a by-pass arrangement of return ducts (3) a method of dripping steam pipes (4) an economical arrangement of piping in district heating distribution (5) an arrangement of piping at the boiler in the return lines.

5. Chimney effect is the (1) condensation of flue gases in a chimney (2) tendency of warm water to rise in a tank (3) tendency in a duct or air passage for air to rise when heated (4) heating of a space by heat from an adjacent chimney (5) contamination of air by smoke.

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Atmospheric Conditions for Storing Flowers

From the Italian Riviera large quantities of cut flowers are shipped to important European cities. As from 21 to 84 hr. are required for delivery, the problem of keeping the flowers fresh was an acute one, reports the "La Revue Generale du Froid." Two Italian engineers, Professor Scurti and Doctor Zavanaju, after making innumerable tests to determine what atmospheric conditions were most favorable to roses and carnations, found that air consisting of 80% nitrogen, 10% oxygen, and 10% anhydrous carbonic acid would preserve roses during shipment for 10 days. Carnations require a mixture of 95% nitrogen, 2.5% oxygen and 2.5% anhydrous carbonic acid to remain in perfect condition for five days. After delivery the flowers have almost the same lasting qualities as those just taken from the garden.

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THE PROBLEM CORNER

A workman busily digging a hole for an oil tank was interrupted by a passerby, who remarked that the hole was already quite deep. To this the man digging replied that probably his shortness made it appear deeper than it was, and said that he was only 5ft. 8 in. tall. When asked how much deeper he planned to dig the hole, he said he would make it just twice as deep as it was then, which would mean that the top of his head would then be twice as far below the surface of the ground as it was then above the surface. How deep will the hole be when finished?

If you are doubtful of your solution, see page 53.

NEWS OF THE MONTH

Los Angeles Has First A.C. Show

LOS ANGELES—Thousands of Southern Californians are more interested in and familiar with air conditioning, following the first public air conditioning show ever held in the far West. For four days, July 7-10, the Thermo Air Conditioning Institute building in Los Angeles was crowded with prospective equipment buyers who were attending the First Los Angeles Air Conditioning, Cooling and Heating Show. Some of the visitors came from as far as Texas, and many from the adjoining states of Arizona, Utah, and New Mexico.

Planned originally as a trade show for contractors and commercial users, the exhibit was expanded to develop general public interest. As the list of displays grew, it became necessary to open an annex on adjoining property, to accommodate the full list of exhibitors. Fifty-three displays, requiring more than 10,000 sq. ft. of space, showed a complete range of equipment for air conditioning, cooling, and heating, including the products of national and local manufacturers. Many exhibitors had equipment in operation, while others showed animated cutouts or diagrams which portrayed the principles by which air is conditioned.

Too large to place in the exhibit halls were the air conditioned bus of the Santa Fe Trailways, and a portable airplane conditioner.

Industrial motion pictures, showing the installation and application of air conditioning equipment and materials, educational talks by leaders in manufacturing and installation, and open forum discussions by members of the industry, were featured on the program each day and evening in the Institute auditorium.

Cooperating organizations were the Air Conditioning and Refrigeration Association of Southern California, the Southern California chapter of the ASHVE, the Electrical Development League, Los Angeles Bureau of Power and Light, Los Angeles Chamber of Commerce, Southern California Edison Company, and Thermo Air Conditioning Institute.

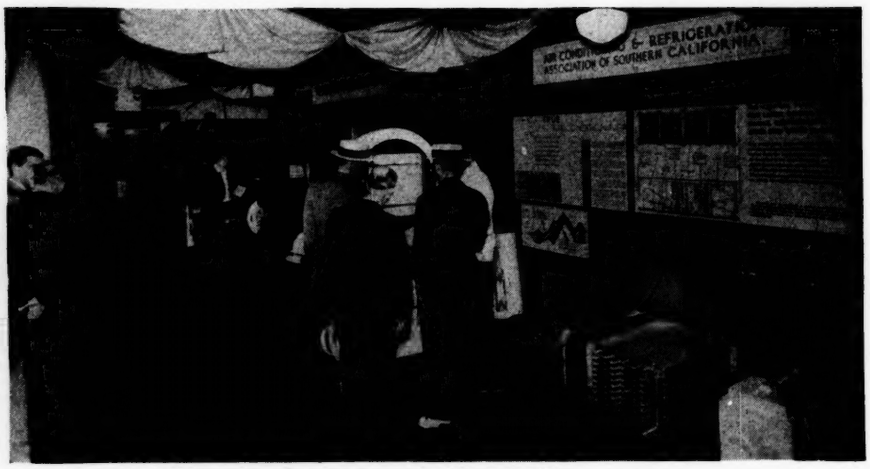
The committee in charge was headed by Howard H. Douglas, of the Southern California Edison Company, and included Ben B. Breslow, Utility Fan Corp., W. E. Cranston, Jr., Thermador Mfg. Co.; Ivan de Jongh, de Jongh-Howells Corp.; E. C. Flynn, Payne Furnace & Supply Co., Inc.; H. F. Haldeman; George Hartman, Hartman Engineering Co.; F. L. Hockensmith, Electrical Development League; Wm. W. Sanford, Thermo Air Conditioning Institute; Earl S. Anderson; Edward H. Kendall, English & Lauer, Inc.; Wm. W. Pearce, Los Angeles Bureau of Power & Light; Dr. Frederick Pernot, Pernot & Rich, Inc.; W. A. Pruitt, Air Conditioning & Refrigeration Association; Emmett Quinn, Pacific Fruit Express; and A. B. Wicks, Department of Building & Safety.

The Thermo Air Conditioning Institute, in whose building this show was held, is a nation-wide training institution for air conditioning and combustion engineers.

ACMA Forms Information Bureau

WASHINGTON—Formation of a bureau of information to serve as a clearing house for feature writers and editors seeking authoritative information on air conditioning is announced by William B. Henderson, executive vice president of the Air Conditioning Manufacturers' Association. Offices will be maintained at the Association's headquarters in the Southern Building here.

Director of the bureau is John T. Schaefer, who has had several years' experience in the air conditioning field.



Some of the booths at the First Los Angeles Air Conditioning Show.

H. B. Smith Boiler Co. Reorganized

BOSTON—H. B. Smith Co., Westfield, Mass., has just been incorporated under Massachusetts laws to manufacture boilers and radiators. Capital consists of $280,435, divided as follows: 56,087 class B shares at $5 each and 18,323 class A shares, no par value. Incorporators are Edwin W. Smith, treasurer; Stanley K. Smith, clerk; A. L. Lawrence, et al. A president has not yet been elected. This incorporation represents the reorganization of the former company of the same name, recently petitioned for under Section 77B.

Mason-Dixon Group Joins NIAA

CHICAGO—The National Industrial Advertisers Association has welcomed its 16th local chapter, the Mason-Dixon Industrial Advertisers, of which Terry Mitchell, advertising manager of The Frick Co., Waynesboro, Pa., is president. This group has been actively associated with NIAA for some time under the name of the Cumberland Valley Industrial Advertisers.

Stoker Committee Chairman Named

CHICAGO—E. C. Sammons, president of the Stoker Manufacturers Association, has announced the following appointments of chairmen of standing committees for the ensuing year:

Advertising and Public Relations committee—J. M. McClintock, Illinois Iron & Bolt Co., Chicago; Commercial committee—B. O. Fink, Auburn Foundry, Inc., Auburn, Ind.; Engineering committee—B. M. Guthrie, Fairbanks, Morse & Co., Chicago; Legislative committee—R. C. Goddard, Combustioneer Div., Steel Products Engineering Co., Springfield, Ohio; Research committee—J. R. Whitehead, Fairbanks, Morse & Co., Chicago; Ways and Means committee—J. E. Martin, Link-Belt Co., Chicago.

60 Miles of Pipe in New Steel Plant

PITTSBURGH.—Blaw-Knox Company, through its power piping division, is completing ahead of schedule the general mill piping for the new Irvin Works of Carnegie-Illinois Steel Corporation. This piping installation is one of the largest ever undertaken in connection with an industrial project. It involves about 60 miles of piping, ranging in size up to 48 in. in diameter, and includes lines for high and low pressure steam; filtered, raw and city water; hydraulic systems up to 3500 lb. pressure; air, fuel and acid supply; and circulating oil and grease systems. Most of the lines were prefabricated to facilitate the field work, and all lines were joined by electric welding except for connections at valves or to machinery equipment.

Russia Studies Power Situation

MOSCOW—An analysis of the present state of heat and power development in the USSR was made, and ways and means for further progress in this field were outlined at the Second All-Union Heat and Power Development Conference recently held in Leningrad. The meeting, attended by about 300 power engineers, executives and representatives of plants producing power equipment from all over the USSR, discussed a number of problems of great significance for industry and municipal services.

The data presented at the conference show the rapid progress of heat and power development in the Soviet Union. During the eight years since the First All-Union Heat and Power Development Conference, 22 district and a large number of factory heat and power stations have been built. Eighty-four electric power stations that combine the production of electric power with the production of heat are now in operation in the country. Last year these stations produced about 21.5 million megacalories—six times as much as in 1931 and 1.5 million megacalories more than planned for 1937 under the Second Five-Year Plan.

Columbia to Repeat A.C. Courses

NEW YORK—The school of architecture of Columbia University will again offer in University Extension this coming winter session a varied group of courses of a professional nature including Air Conditioning I and II. Other courses include building estimating, acoustics of buildings, architectural drafting, architectural construction, and many others.

Air Conditioning I is a basic or general course outlining the scope of the industry, its field of activity, and its fundamental principles. This course is given by Edwin H. Taze, a specialist in steam jet refrigeration.

Air Conditioning II is a technical course for advanced students in mechanical engineering with admission to the class subject to the approval of the instructor. The instructor in this course is Albert J. Lawless of Hubbard, Richard and Blakeley, consulting engineers of New Haven and Boston.

ANSWER TO THE PROBLEM ON PAGE 51

Let X = depth of hole in inches
The workman's height = 68 in.
Then $2X - 68 = 2(68 - X)$
or $4X = 204$, and $X = 51$ in., or 4 ft. 3 in.
Therefore, the final depth will be $2X = 8$ ft. 6 in.

A.C. Cuts Jeweler's Cleaning Cost

BOSTON—A total of eight air conditioning installations, with an aggregate of 72 hp., are reported by the Boston Edison Company for its territory during April. These were all commercial installations, including three restaurants, a hall using well water for cooling, an ice cream distributor, two shoe stores and a jeweler. In May there were 22 more installations, with an aggregate of 529 hp.

The largest of these latter were the Massachusetts General Hospital with a 200-hp. plant, the offices of the General Electric Supply Company, with 120-hp., and finally the Rivoli Theater, with 65 more. One notable installation was that in the mushroom plant of Arthur Rowe in Woburn. One residence and one bank are also included.

Further than that, the 116-year-old jewelry firm of A. Stowell & Company continued its modernizing policy by adding a year-round air conditioning system of 12-hp., back in March, early preparation for the June wedding trade, of which this firm makes a specialty. The management reports an improvement in the appearance of the merchandise and a reduction of cleaning costs, beside the added comfort for customers and employes. Here, except for a 10-hp. compressor in the basement, all the conditioning equipment is located in a cabinet on the first floor.

N.Y. Gas Heating Men Elect Schaul

NEW YORK—The New York Metropolitan House Heating Council has elected the following officers for 1938-39:

President, H. G. Schaul, Westchester Lighting Co.; vice-president, R. A. Malony, Bridgeport Gas Light Co.; secretary-treasurer, Otis Barene, New York & Richmond Gas Co.

Chinese Restaurant Conditioned

BOSTON—China in some respects may be a backward nation, but those who conduct Chinese restaurants in this country are up and coming when they learn of anything that will increase their business. The first Chinese restaurant here to adopt air conditioning and install a summer system was Ruby Foo's Den, at 6A Hudson Street, in the heart of Chinatown.

With the installation of a system that filters, cools and dehumidifies the air, and removes smoke, this place has become one of the most popular in Boston's Chinatown. Although the system was designed for summer conditioning only, it was found necessary to operate the equipment nearly the year 'round, owing to the concentrated heat load in the low ceilinged rooms. Volume of business has increased 25% and added close to $20,000 to gross receipts during the past year.

Senner Working on Orchard Heaters

BALTIMORE—A. H. Senner of the Department of Agriculture and author of a number of bulletins on oil burners published by that department, is working on air atomizing oil burners for orchard heating. Several heaters have been constructed and two are being shipped to California for further testing.

Carlson Heads St. Louis Chapter

ST. LOUIS—The St. Louis chapter of the ASHVE held its annual dinner and dance Wednesday evening, June 15, at the Norwood Hills Country Club.

The officers elected by the local chapter for the season 1938-39 are: E. E. Carlson, president; R. J. Tenkonohy, first vice-president; C. E. Hartwein, second vice-president; D. J. Fagin, secretary, and M. F. Carlock, treasurer.

F. H. Currier

MAPLEWOOD, N. J.—F. H. Currier, sales agent for the New York area of the National Pipe Bending Co., New Haven, Conn., for more than twenty years, died suddenly while in a tennis match near his home here, June 19. He was 49.

Mr. Currier is survived by his wife and two children.

Theodore Ahrens

LOUISVILLE, KY.—Theodore Ahrens, until 1936 president of American Radiator and Standard Sanitary Corp., died here June 12. He was 79.

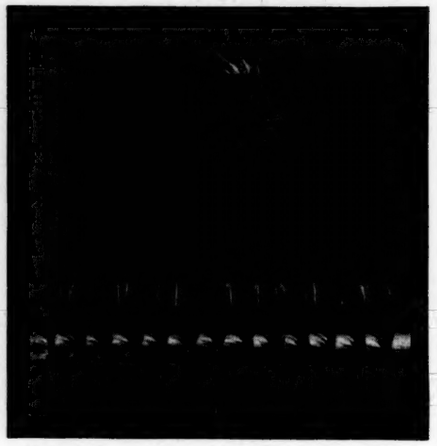
At the age of 21, Mr. Ahrens entered the plumbing business. In 1886 he helped to organize the Ahrens & Ott Manufacturing Co., a plumbing supply firm. At the turn of the century he consolidated ten manufacturers of plumbing fixtures into the Standard Sanitary Manufacturing Company. Named its first president, he headed the organization for thirty years.

In 1929 he helped to form the American Radiator and Standard Sanitary Corporation, retiring seven years later for a directorship. He remained chairman of the board of the Standard Sanitary Manufacturing Company until his death.

Mr. Ahrens donated $500,000 toward the establishment of the Theodore Ahrens Trade School in Louisville. He endowed a chair of heating, ventilation and plumbing at Carnegie Institute of Technology at Pittsburgh, where he had maintained his office for many years.

Mr. Ahrens is survived by his widow, a daughter, a sister, a grandson and a granddaughter.

NEW EQUIPMENT



Peerless Extended Surface Coils

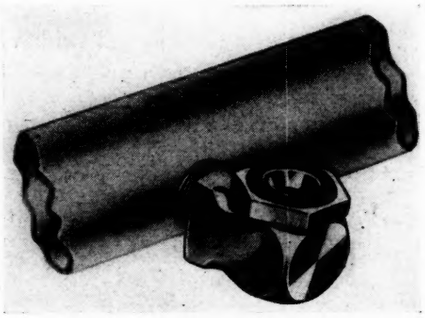
NAME—Peerless High Dispersion coils.
PURPOSE—For heating or cooling air using steam, water or refrigerant.
FEATURES—This coil differs from the usual surface coil in that a large amount of spines are used in place of the usual flat fins. These coils are made by cutting from the outer surface of thick walled copper tubing hundreds of slender spines. The spines are bent so that they are in an erect position and since they are made from the copper tube there is a perfect bond between them and the tube itself. The manufacturer states that constructing a coil in this manner increases the heat transmission greatly because the insulating air film surrounding the spines is extremely thin. It is said that the thousands of spines create considerable turbulence which helps to increase the heat transfer; however, because of the high efficiency the tubes are considerably shallower than ordinary fin coils and therefore the air friction through the coil is not unfavorably affected. The coils are standardized and have the following dimensions: overall diameter, 2 in.; helical spacing of rows of spines, ⅛ in.; number of spines per turn, 40. Supporting frames and end plates are constructed of brass and when the coils are assembled they are electro-tin plated as a unit to protect them against corrosion. Coils are available for heating or cooling using water, steam, or direct expanded refrigerant.
MADE BY—*Peerless of America, Inc., 515 W. 35th St., Chicago, Ill.*.....*1*

Maid-O'-Mist Water Feeder

NAME AND MODEL NUMBER—Water feeder, Model No. 50-F.
PURPOSE—For regulating the flow of water to humidifier pans.
FEATURES—This feed has a nickel-plated copper float which is 1½ in. in diameter and which is said to operate the valve in as little as 1 in. of water. Thumb screw adjustment on float arm governs the water depth at which the valve closes. A large filter with a monel metal screen protects the valve from pipe scale. The bearings are of monel metal. The entire valve is nickel-plated and is equipped with 6 ft. of ¼ in. outside diameter copper tubing, and a quick hookup saddle valve. The unit can be installed through a ⅝ in. hole in the wall of the humidifier fan.
MADE BY—*Maid-O'-Mist, Inc., 180 N. Wacker Drive, Chicago, Ill.* *2*

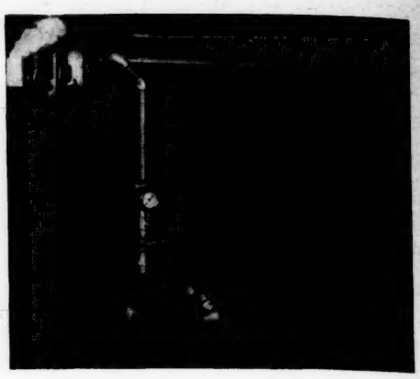
Spraying Systems Spray Nozzles

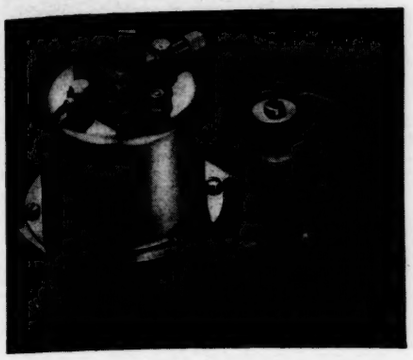
NAME—Whirljet.
PURPOSE—For roof cooling using city water or condenser cooling water.
FEATURES—Non-clogging with wide spray angle, giving wide coverage and a height spray less than the average parapet wall. It is stated that the cost of installation is low because of the small number of nozzles necessary and the small amount of water required to keep the roof moist.
SIZES—¼ in. male pipe connection, removable cap.
CAPACITIES—0.45 g.p.m. at 6 lb. pressure.
MADE BY—*Spraying Systems Co., 4922 W. Grand Ave., Chicago, Ill.*....*3*



Capillary Air Conditioning Units

NAME—Capillary air conditioning units.
PURPOSE—A device to bring air and water into contact for purposes of humidifying or dehumidifying.
FEATURES—The basic part of the capillary conditioner is the cell, or cells, each one of which is a rectangular casing filled with an oriented mass of fine glass filaments. The cell casing is open at the top and bottom, except for 2-in. mesh heavy wire screens. These hold in place thin layers of glass filaments, arranged in a horizontal direction, between which the vertical strands are held. The horizontal filaments have no appreciable effect on the resistance to flow of air or water. The manufacturer states that the number of filaments in a standard 20 x 20 in. cell is approximately 57,000. In operation water in the form of large drops or small streams is permitted to fall on the top layer of horizontal filaments. It then tends to spread and run along these until collection in mass causes it to fall on or transfer itself to the vertical strands below. As it then flows down these vertical strands by gravity, capillarity retards its rate of motion and causes it to spread out in an extremely thin film. At the lower end of the vertical strands the surplus of water is transferred to the bottom horizontal layer, where it clings by capillarity until it forms drops large enough to fall into a collecting pan below. Simultaneously with this the air, propelled by any standard type of fan or blower, passes through the cell in about 60,000 separate streams. The manufacturer states that the mechanical effect of this is to make the film still thinner, while at the same time the presence and flow of the water lubricate the passage of air. It is stated that in actual practice a packing 8½ in. deep gives saturating efficiencies in excess of 95% even when used with temperatures as low as 35 to 50F. It is also stated that the air is cleaned as well as humidified or dehumidified when it passes through this conditioner. The manufacturer claims that all solid matter down to 5 microns and most microns down to 1 are removed. Foreign particles adhering to the flowing water surfaces are carried into the tank below where they are picked up in the strainer or washed into the sewer. This type of conditioner may be used in all cases where the common practice of recent years would have specified spray washers. Since the conditioner cleans the air it is claimed that no additional filters are necessary except in those installations where large amounts of lint or hair are encountered. These conditioners are available in many sizes and arrangements for different applications. Complete capillary air conditioners, embodying all the essential parts necessary for complete treatment of the air, are available.
MADE BY—*Air & Refrigeration Corp., 11 W. 42nd St., New York*.....*4*





General Space Heater Control

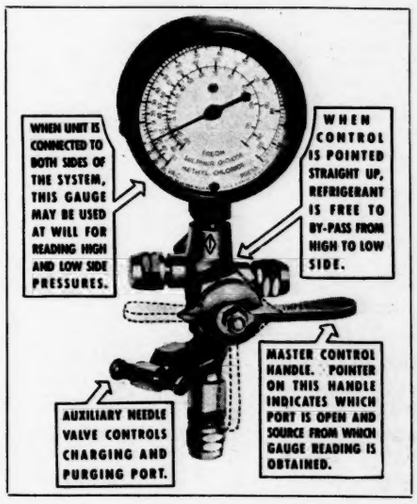
NAME—General gas-fired space heater control.
PURPOSE—For automatic control of gas-fired space heaters.
FEATURES—No outside source of current is needed since a small pilot burner generator supplies the electric current for operation. According to the manufacturer this accomplishes a threefold purpose: (1) to check the pilot flame providing an automatic pilot control; (2) provides current for valve operation; (3) permits the use of an integral electric type thermostat with ½F total differential. The thermo-couple principle is used to generate the necessary current to operate the pilot control valve, obtaining its energy from the gas flame. The main valve is a gas-actuated diaphragm type. Since the current to operate the pilot valve is generated by the heat from the gas flame, any failure of the pilot flame automatically causes it to close. The unit is self-contained except for the pilot burner. It may be used for the control of circulating heaters, range heaters, gas radiators, floor furnaces, and like devices.
MADE BY—*General Controls Co., 450 E. Ohio St., Chicago, Ill.*.....5

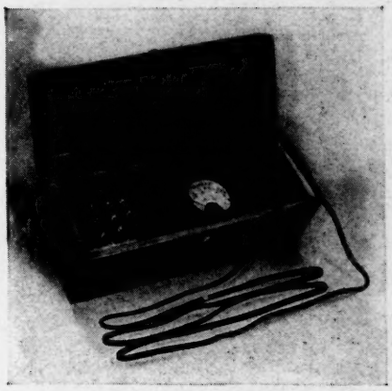
Advance Fan Wheel

NAME—Castalu cast aluminum fan wheel.
PURPOSE—A blower type fan wheel with the hub cast to form the driven unit of a flexible coupling.
FEATURES—It is said that by having a flexible coupling driven unit as an integral part of the fan, motors having standard shafts can be used, and approximately one-third of the cost of the flexible coupling is saved. When, due to the design of the equipment, additional distance between the motor and fan is required, instead of using a non-standard motor shaft or extra length hubs, a low cost, oil-proof synthetic rubber flexible coupling center unit of the right length is installed. The design of the blower itself is said to fulfill requirements for oil burners by being noiseless; for stokers by giving an air stream of ample pressure; and for air conditioning equipment by producing plenty of volume without noise. Fan is cast in one piece of non-corrosive and light weight aluminum and it is said to be accurately balanced and fitted with a set screw.
SIZES AND TYPES AVAILABLE—Fans operate either clockwise or counter-clockwise and are available in all standard sizes from 3 x 1½ in. to 10½ x 5¼ in.
MADE BY—*Advance Aluminum Castings Corp., 2742 W. 36th Place, Chicago, Ill.* 6

Imperial Refrigeration and Testing Unit

NAME AND MODEL NUMBER—Imperial Hi-Lo charging and testing unit. No. 500-C.
PURPOSE—A single gage charging and testing unit for refrigeration and air conditioning work.
FEATURES—Among the special advantages claimed for this unit are: (1) when connected to both sides of the system, it will give the pressure readings of both the high and low sides with a single gage and single valve; (2) it permits bypassing at any time without capping the charging and purging port; (3) it may be used separately on the high side or low side with maximum convenience. The unit has a single master control handle which operates a double-acting valve. When this control is turned so that its pointer is toward the high side connection, the high side port is opened and the pressure gage shows the high side pressure. When it is turned toward the low side connection, the low side port is opened and the pressure gage shows the low side pressure. If control is pointed upward, both ports are opened and the gas is permitted to pass from the high to the low side. An auxiliary needle valve is also provided which controls the charging and purging port at the center. The unit is equipped with a 30-in. to 150-lb. compound gage with temperature scale.
MADE BY—*The Imperial Brass Mfg. Co., 1200 W. Harrison St., Chicago*...7


WHEN UNIT IS CONNECTED TO BOTH SIDES OF THE SYSTEM, THIS GAUGE MAY BE USED AT WILL FOR READING HIGH AND LOW SIDE PRESSURES.
WHEN CONTROL IS POINTED STRAIGHT UP, REFRIGERANT IS FREE TO BY-PASS FROM HIGH TO LOW SIDE.
MASTER CONTROL HANDLE. POINTER ON THIS HANDLE INDICATES WHICH PORT IS OPEN AND SOURCE FROM WHICH GAUGE READING IS OBTAINED.
AUXILIARY NEEDLE VALVE CONTROLS CHARGING AND PURGING PORT.

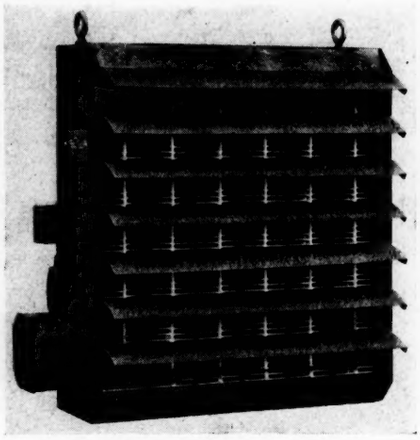


Willson Thermo-Anemometer

NAME—Willson Thermo-anemometer.
PURPOSE—For determining air velocities between 0 and 6000 f.p.m.
FEATURES—To determine the velocity of air movement at a given point, the bulb of the heated thermometer is held at the point in question and the temperature read as soon as it attains equilibrium. The thermometer bulb is heated by passing an electric current through the resistance wire on the bulb from batteries contained in the instrument case. The voltage used should be such as to give a temperature difference between the heated thermometer and the regular thermometer of not less than 15°. As the accuracy increases with the temperature difference, a temperature differential of 25 to 35F is desired whenever practicable. Knowing the temperature difference and the voltage used, the air velocity is read from the accompanying chart.
MADE BY—*Willson Products, Inc., 332 Thorn St., Reading, Pa.* 8

Baldor Glass-Insulated Stream Cooled Motor

NAME—Baldor glass-insulated Streamcooled motor.
PURPOSE—An air-cooled, glass-insulated electric motor.
FEATURES—These motors are the standard Baldor open motors in integral sizes, now solidly enclosed and protected against dust, dirt, splash and danger of internal damage to the motor. They are cooled by means of an outer fan blowing a stream of air directly over the outside of the exposed laminations. A glass-woven fabric is used as insulating material in this motor. It is said that this material is unaffected by moisture and is resistant to acid and oils, is fireproof, and will not decay. The manufacturer states that the use of glass as an insulating material, plus Streamcooled design makes possible a motor considerably smaller in size and lighter in weight than the older type.
SIZES AVAILABLE—1½ to 20 hp. in three-phase, 220/440 volt, 60 cycle, 1725 r.p.m. motors.
MADE BY—*Baldor Electric Co., 4400 Duncan Ave., St. Louis, Mo.* 9



Electric Unit Heaters

NAME—Electromode standard industrial heaters.

PURPOSE—For supplying warm air, using electricity as a heat source.

FEATURES—Heating grid is made of aluminum cast on the tubular heating element. The manufacturer states that a cast-in construction seals the heating element, preventing oxidation and deterioration. It is also claimed that the aluminum fins permit low temperature operation. The unit consists of these aluminum grids, a four-blade aluminum propeller fan, a totally-enclosed motor, adjustable louvers for directing the heated air, a cabinet built of heavy lead coated steel and aluminum castings, and a safety switch which automatically disconnects the heater in case the fan is overheated, and a standard terminal box.

SIZES AND CAPACITIES—Ten sizes with capacities ranging from 34,150 to 614,700 B.t.u. per hr.

MADE BY—*Electric Air Heater Co., Div. of American Foundry Equipment Co., Mishawaka, Ind.* *10*

Insto-Gas Torch

NAME AND MODEL NUMBER—Insto-Gas torch, No. 2.

PURPOSE—For light brazing and soldering of copper pipe fittings up to ¾ in. in diameter.

FEATURES—It is said that this new torch produces a brush-type blast flame ranging from 3 in. long and ⅜ in. in diameter to 8 in. long and ⅝ in. in diameter. The manufacturer states that this torch eliminates the danger of burned spots and overheating. Temperatures up to 2500F are said to be possible with this torch.

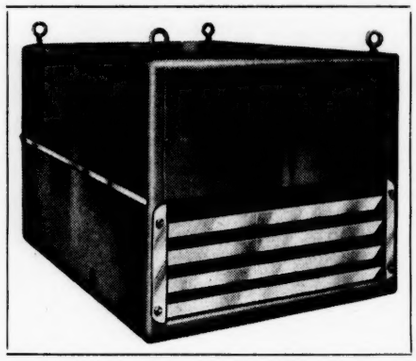
MADE BY—*Insto-Gas Corp., 1900 E. Jefferson Ave., Detroit, Mich.* *11*

Johnson Air Cooling Unit

NAME—Health-aire-konditioner.

PURPOSE—For supplying cooled air for homes, offices and stores using cold water as a cooling medium.

FEATURES—This device consists of a specially designed water cooling coil, a high capacity quiet operating multi-blade fan which is connected by a V-belt drive to the motor, and a brown crackled finish housing. The units are designed for ceiling mounting. The amount of cooling is controlled by regulating the flow of water through the unit.



SIZES AND CAPACITIES—Six sizes with capacities ranging from 1 to 5 tons of refrigeration with a 60F water temperature. Air supplied ranges from 720 to 3490 c.f.m.

MADE BY—*Johnson Fan & Blower Corp., 1319 W. Lake St., Chicago*....*12*

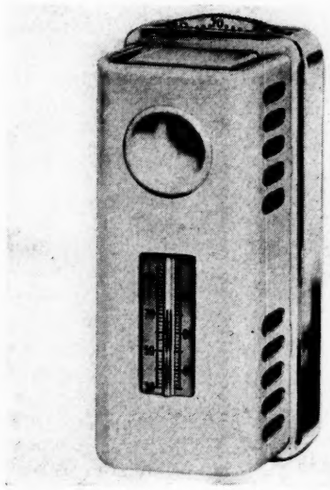
White-Rodgers Thermostat

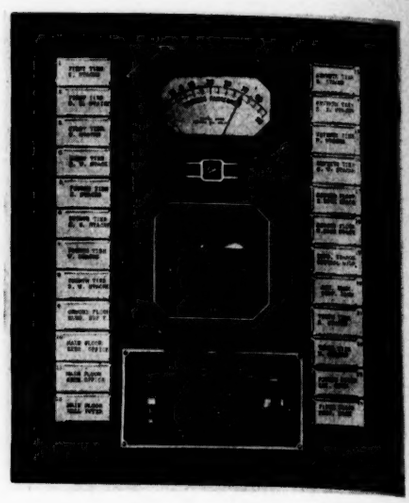
NAME—Line voltage room thermostat.

PURPOSE—For controlling the temperature in heated or cooled spaces.

FEATURES—The manufacturer states that the modern lines and ivory and chromium finish make this an ideal instrument for air conditioning service in stores, restaurants, and public buildings. It may also be obtained in a black and chromium finish. The range on heating types is 55F to 80F and cooling types, 65F to 95F. Thermostat is available with locked cover and tamperproof adjustment, if desired, and with or without a thermometer. The switch has a load capacity of 1½ hp. at 120 or 240 volts a.c., 30 amp. at 120 volts a.c., or 15 amp. at 240 volts a.c. Also suitable for use on low voltage.

MADE BY—*White-Rodgers Electric Co., 1209 Cass Ave., St. Louis, Mo*...*13*





Minneapolis-Honeywell Indicating Thermometer

NAME—Brown indicating resistance thermometer.

PURPOSE—For indicating temperatures from thermocouples located in any number of points within a building on a central dial.

FEATURES—The manufacturer of this device states that this instrument makes it possible for the operator to easily check on temperatures at all sections of the building. Thermocouples are placed at any location where it is desired to keep a check on the temperature. These thermocouples operate an indicating thermometer located in a convenient central place.

MADE BY—*Brown Division, Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.* *14*

Pierce-Butler Boiler

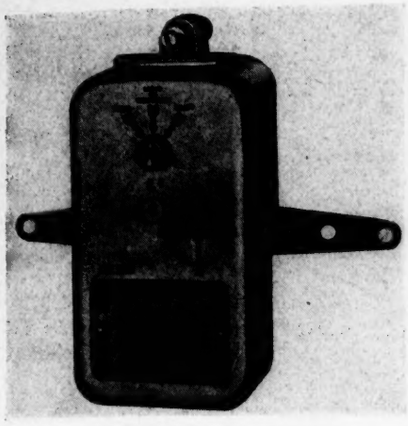
NAME—Pierce-Century boiler.

PURPOSE—For supplying steam or hot water using coal or oil.

FEATURES—This boiler is manufactured in one size only to heat an average small house. Two unit castings and a base make up the boiler proper. There is a four-way flue gas passage with no fins to collect soot or fly-ash. Three grates are employed and all couplings and shaking connections are outside of the ashpit. By removing the front plate of the base, a stoker-fired retort can be installed in the high ashpit. Boiler is shipped with both sections and the front doors completely assembled and puttied. On the oil-fired model the boiler door is tightly sealed by safety lock latches. The sight glass in this door makes possible the inspection of the combustion chamber at all times. Submerged heating coils are used to supply domestic hot water.

SIZES AND CAPACITIES—Boiler made in one size for either coal or oil. Coal rating, 350 sq. ft. installed radiator surface; oil rating, 350 sq. ft.

MADE BY—*Pierce-Butler Radiator Corp., 701 Nichols Ave., Syracuse, N. Y.* *15*

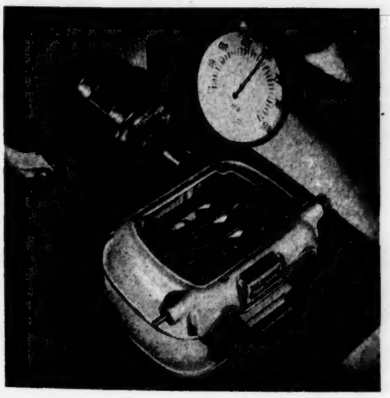


Gleason-Avery Motor

NAME—Low-voltage control motor.
PURPOSE—For operating from controls using a 20-volt current.
FEATURES—Motor operates on 20 volts drawn from a step-down transformer with a 110-volt input. An ordinary two-wire low-voltage cable, furnished with the motor, is used to complete the installation. The manufacturer states that the use of low voltage decreases the cost of installation both because of the reduced cost of wiring and the reduced cost of the motor. The thermostat controlling the motor is the same as that used in the high-voltage installations.
MADE BY—*Gleason-Avery, Inc., Auburn, N. Y.* *16*

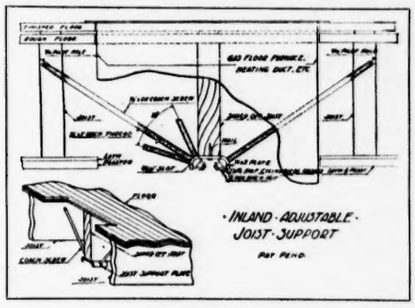
Allis-Chalmers Speed Changer

NAME—Vari-pitch speed changer.
PURPOSE — Connecting device for providing a variable speed drive.
FEATURES—This speed changer utilizes the principle of the Allis-Chalmers vari-pitch sheave. It is totally enclosed and is designed with a double shaft extension and can be driven from any standard motor. Where the change in speed is to be adjusted manually only, the unit is provided with a readily accessible hand wheel control. The unit may also be equipped for electric or manual remote control.
CAPACITIES—Up to 33 hp. with speed ratios as high as 3¾ to 1.
MADE BY — *Allis-Chalmers Manufacturing Co., Milwaukee, Wis.* *17*



Inland Adjustable Joist Support

NAME—Inland adjustable joist support.
PURPOSE—For supporting joists which must be sawed to permit installation of heating or air conditioning equipment.
FEATURES—This device consists of two heavy lag screws, machine threaded for hexagonal nuts at the head, and joined by a metal plate, slotted to permit the screws to turn to any angle. One nail fastens this metal plate to the joist which is to be supported. Pilot holes are drilled in adjoining joists with a wood drill. The lag screws are turned into these holes, washers and nuts are applied, and the joist is fully supported. The manufacturer claims that this device will support a dead weight of over a ton on a 2 x 6 joist.
MADE BY—*Inland Mfg. Co., 1120 N. Cicero Ave., Chicago, Ill.*.....*18*

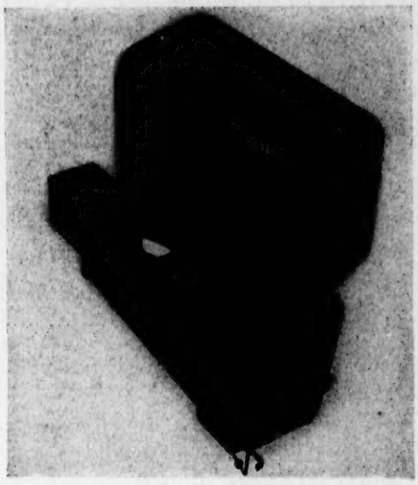


Goetze Valve Discs

NAME—Goetze valve discs.
PURPOSE—All-purpose renewable discs recommended for handling air, gas, steam and liquids at any temperatures or pressures or for any service in which a globe valve may be used.
FEATURES—Valve discs are of laminated construction, built up of alternating layers of asbestos and metal completely encased in a two-piece shell of copper, Monel or other alloy metal. Shell is said to effectively protect the laminated parts of the discs and is said to afford flat seating surfaces, both top and bottom, and to allow the upper ring freedom of movement under compression.
SIZES—For ¼ to 12 in. valves with round or oblong holes.
MADE BY—*Goetze Gasket & Packing Co., Inc., New Brunswick, N. J.*.....*19*

Gehl Stoker

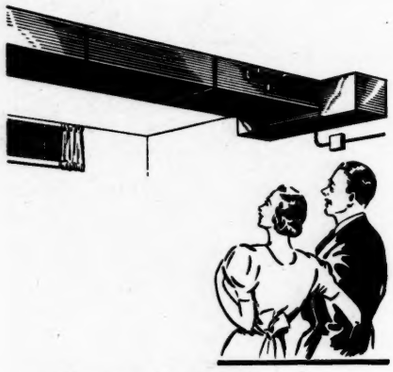
NAME—Domestic stoker.
PURPOSE — For automatic firing of coal.
FEATURES—The manufacturer states that by simplifying the design and at the same time retaining most of the features of the regular line, economies have been obtained which make possible a low price. Stoker incorporates the same type of chassis construction as the regular models and also has a Gehl air governor and continuous drive



transmission. A new feature of this stoker is a double pulley arrangement which makes it easy to adjust the air and coal feeding capacity to meet the specific requirements of each installation. Controls supplied with this stoker are room thermostat, timer relay or switch and limit control. Stoker is finished in red and deep blue.
MADE BY—*Gehl Brothers Mfg. Co., West Bend, Wis.* *20*

Industrial Room Cooler

NAME—Bruce room cooler.
PURPOSE—For room cooling using ice.
FEATURES—The cabinet is equipped with six heat exchangers (ice containers) over which the filtered air is forced. A motor-driven blower is used to circulate the air to the cooler. The air drawn from the room first passes through a filter and then into the fan. The fan forces the clean air over the corrugated surfaces of the ice containers and then out of the register at the top. The ice containers are so arranged that the air passes over them in series. A small amount of the cooled air is bypassed back to the fan through a beverage storage compartment. This makes it possible to use the cooler for cooling bottled drinks and drinking water. Ice storage capacity is 300 lb.
MADE BY—*Industrial Air Conditioning Co., Inc., 1317 Glenwood Ave., Minneapolis, Minn.* *21*

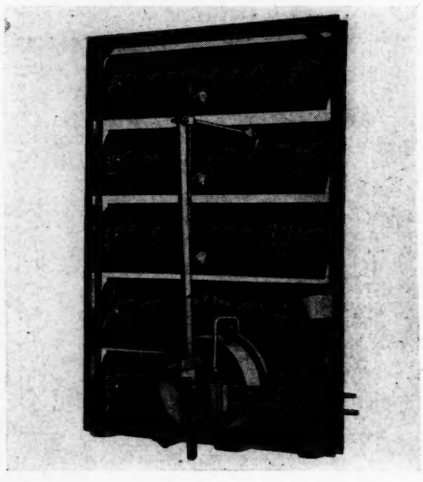


Gasconaire Gas Furnace

NAME—Gasconaire overhead gas furnace.
PURPOSE—A gas fired warm air furnace for installation on the basement ceiling.
FEATURES—Furnace is designed to be suspended overhead in the basement. Its top is insulated with one inch of air cell insulation to prevent heating of the basement ceiling. Two filters are employed for air cleaning and a double blower is used for moving the air. The gas is burned in a dual-chamber gas burner and the air is heated by passing it over a long horizontal heat radiating surface. A small vent pipe and draft blower are used to carry off the flue gases. An automatic humidifier is used to humidify the air. Electric ignition is provided on the gas burner. Controls provided include an automatic gas valve, pressure regulator, summer switch, blower and limit control and a 2 speed blower control.
MADE BY—*Gasconaire, Inc., 3255 Goldner Ave., Detroit, Mich.....22*

Minneapolis-Honeywell Relay

NAME—National Gradutrol relay.
PURPOSE—To eliminate hunting in pneumatic valves and dampers, and by assuring positive air pressure at all times to convert conventional pneumatic control into a system where any degree of graduation is possible.
FEATURES—The manufacturer states that the maximum power of pneumatic motors is made instantly available for adjusting valves and dampers accurately to any one of the infinite number of positions that the graduate thermostats and controllers are capable of demanding. It is further stated that true graduation prevents wide fluctuations caused by varying air velocities or friction in valves and dampers.
MADE BY—*National Division, Minneapolis-Honeywell Regulator Co., Minneapolis, Minn. 23*

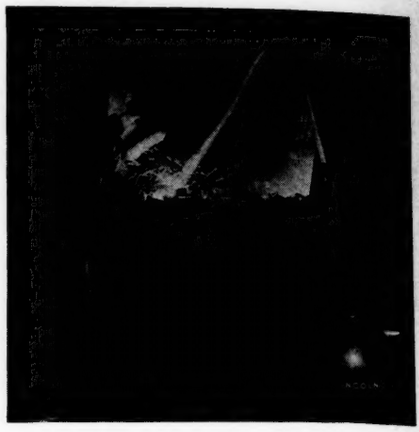


Smith Copper Tube Sizing Calculator

NAME—F. G. Smith copper tube sizing calculator.
PURPOSE—For the economical choice of copper tubes for forced circulation hot water systems.
FEATURES—This calculator was designed by F. G. Smith, service engineer of the American Brass Co., Waterbury, Conn. The sliding scales of the calculator are so designed that they not only provide the necessary information in condensed form, but also permit the user to arrive at the sizes of tubes required much more rapidly than when using the tables ordinarily depended upon. Any small forced circulation reversed return system can be correctly sized with one setting of this calculator. The size of the main supply and return piping for a direct return or one-pipe system can also be found with one setting. The friction losses of all sections of the main can be found. When the head of each riser or offset and the length of each riser or offset are known, the nearest tube size can be determined according to the load which it must carry.
CALCULATORS AVAILABLE FROM—*F. G. Smith, 73 Woodside Ave., Waterbury, Conn. 24*

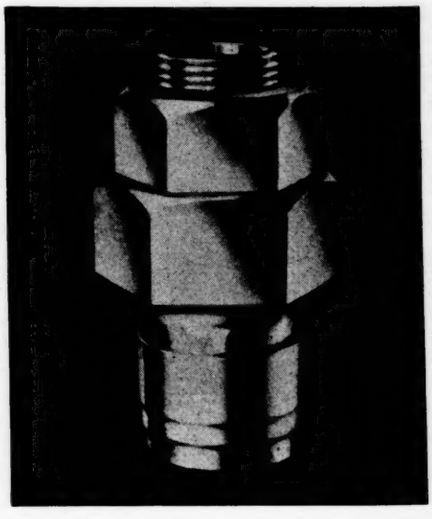
Lincoln Air Cleaner

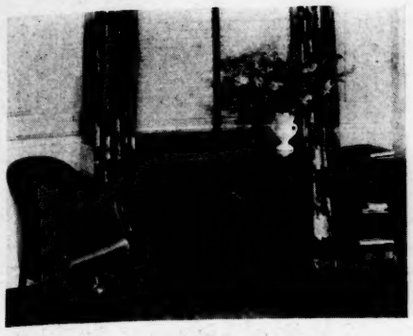
NAME—Linconditioner.
PURPOSE—For supplying clean air in the vicinity of grinding, welding and other shop operations and for drawing smoke and heat away from work so as to improve shop conditions and the efficiency of welders.
FEATURES—This device consists of a motor-driven fan which produces a suction through a flexible metal tube. The fan draws air through the flexible tube and exhausts it in a filter which is located at the periphery of the power unit. The flexible tube is supported by a welded steel arm and spring arrangement so that the nozzle can be shifted to any desired spot within the radius of the tubing. When used for removing and filtering the air, a rubber cap is kept over the blower outlet. When used for blowing, the rubber cap is removed and the flexible tube is placed in the blower outlet. When the device is used for the removal of smoke the exhaust or blower outlet may be connected to a header which leads to the outside of the building. With this setup the air passes through the Linconditioner and is not exhausted into the filter. Fan is driven by ½-hp. motor.
MADE BY—*The Lincoln Electric Co., Cleveland, Ohio. 25*



Multi-Seal Pipe Connector

NAME — Multi-seal front drive pipe connector.
PURPOSE—A fitting which is used to attach pipes to tanks, drums, boilers, or other pipe from the outside.
FEATURES—This device is designed to make it possible to attach pipes to containers without having to get on the inside. The manufacturer states that it is unnecessary to shut down the plant while draining and flushing tanks and also eliminates the use of boiler flanges. The device is installed by inserting it in the hole and then while holding the body with a wrench, turning the action nut. The connection is then ready for attachment to the line. It is said that this connection may be used on steam, gas, oil, water and air and will stand high pressures.
MADE BY—*Multi-Seal Manufacturing Co., 123 N. Jefferson St., Chicago....26*





Coolmaster Room Cooler and Humidifier

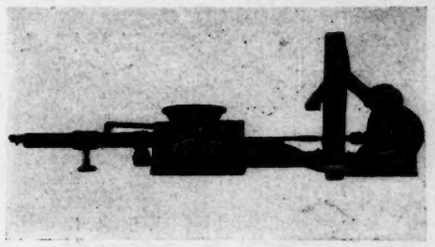
NAME—Coolmaster.
PURPOSE—For cleaning and cooling the air during the summer by evaporation and for cleaning and humidifying air during winter.
FEATURES—The Coolmaster is a self-contained cooling device designed to provide summer cooling by evaporation in localities where the humidity conditions are relatively low. The unit is placed on the floor in front of a window with an air intake extending to the open window. Fresh air is drawn into this intake, cleaned, washed and then discharged into the room. Approximately 700 c.f.m. of air is forced into the room. The water compartment on the unit may be filled by hand or connected with the city water line. No drain connection is required. During the winter a damper is closed in the window duct. This automatically closes the outside air intake and causes the Coolmaster to recirculate the room air. It is said that the Coolmaster will evaporate up to 1 gal. of water per hr. The unit is housed in a cabinet which is made of steel and finished in dark walnut. The manufacturer states that tests have shown that the washing and filtering process will remove upwards to 99% of hay fever pollen and germ-carrying dust.
APPLICATION—Manufacturer recommends the use of this machine for cooling in locations where the wet bulb temperature of the outside air does not exceed 75F.
MADE BY—*Coolmaster Corp., 530 S. Dearborn St., Chicago, Ill.* 27

Reynolds Split Phase Motor

NAME—Reynolds permanent split phase motor.
PURPOSE—An alternating current motor having variable speed characteristics for use with fans or blowers or other similar low starting torque service.
FEATURES—This type of motor is essentially a shaded pole design, that is, a shading pole winding is employed to produce a split field and to permit sub-synchronous operation. A starting winding is employed as in the split phase type, except that this winding is permanently connected to the main winding. To obtain speed variability the applied voltage is varied by means of a suitable rheostat of a tapped choke coil. The 1140 r.p.m., 60-cycle a.c. sizes have a useful operating range of from approximately 1150 to 850 r.p.m. with most fan blades. Motor has the characteristics of a rather low starting torque, relatively efficient full load characteristics and rather high breakdown torque.
SIZES AND CAPACITIES—The 1140 r.p.m. type is at present built in sizes ranging from 1/20 to 1/6 hp.
MADE BY—*Reynolds Electric Co., 2650 W. Congress St., Chicago, Ill...28*

Sinker-Davis Stoker

NAME—Fire-King anthractie burner.
PURPOSE—For automatic firing of anthracite coal from the bin.
FEATURES—Square type transmission with solid bronze cast gears submerged in oil, Fire-King Airtrol and silencer, anti-friction well type hopper and special type feed worm. The manufacturer states that no change of the location of coal bin or furnace is required to install this stoker since a direct line connection is made from the motor and transmission through the furnace and into the coal bin. The manufacturer states that these models will be sold at a price below $300 including standard controls and installation.
SIZES—Made in three sizes with 12-, 15- and 18-in. retorts.
MADE BY— *The Sinker-Davis Co., 230 S. Missouri St., Indianapolis, Ind....29*



Resistoflex Flexible Tubing

NAME—Resistoflex PVA tubing.
PURPOSE—A flexible tubing for carrying fuel oils.
FEATURES—Resistoflex is a trade mark and name employed to describe a flexible synthetic resin which is said to be inert to gasoline, oils and organic solvents. Physical characteristics are said to include extreme lightness, great toughness, good elasticity and flexibility. At present this resin is offered in the form of tubing in sizes up to ½ in. I.D. although the gaskets, washers, packing, diaphragms and sheet material are scheduled for later production.
MADE BY—*Resistoflex Corp., 370 Lexington Ave., New York.* 30

Master Kraft Room Cooler

NAME AND MODEL NUMBER—Master Kraft room cooler, Model C-10.
PURPOSE—For room cooling and supplying cold drinking water.
FEATURES—Conditioner unit is portable and need only be backed up to a window and the electrical wire plugged into a convenient socket. The design of the cabinet has been developed to bring the cold air into the room at an angle which is outward and upward, to prevent any draft of cool air in the occupied portion of the room. This angle of the incoming air is also governed to prevent a short circuiting of the air flow. The unit, besides cooling the air, also incorporates a water cooling container which is connected to tap water or a bottle of spring water to supply cold drinking water. The refrigerant used is Freon.
CAPACITY—5000 B.t.u. per hour.
MADE BY—*Harvey-Whipple Incorporated, Springfield, Mass.* 31

TO OBTAIN FURTHER INFORMATION ON NEW EQUIPMENT

On the list below circle the item number of the equipment in which you are interested, using the identifying number found at the end of each description

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

Fill in your name and address, detach and mail to
HEATING & VENTILATING
148 Lafayette St.,
New York, N. Y.

Name .....
Title .....
Firm .....
Business Address .....
City and State 8/38

Degree-Day Figures for June, 1938

HEATING & VENTILATING concludes its tenth year of publishing degree-day data for various large cities

	Albany, N. Y.	Atlanta, Ga.	Baltimore, Md.	Birmingham, Ala.	Boston, Mass.	Buffalo, N. Y.	Burlington, Vt.
Degree-days for June, 1938	32	1	8	0	51	62	46
Deg.-days, season 1937-38, Sept. to June	6238	2835	4186	2442	5946	6705	7654
Deg.-days, season 1936-37, Sept. to June	6088	2727	4141	2367	5700	6621	7521
Deg.-days, Sept. to June, incl., Normal	6580	2890	4533	2352	6045	6822	7514

	Cheyenne, Wyo.	Chicago, Ill.	Cincinnati, Ohio	Cleveland, Ohio	Columbus, Ohio	Denver, Colo.	Des Moines, Iowa
Degree-days for June, 1938	122	25	3	20	3	31	3
Deg.-days, season 1937-38, Sept. to June	7080	6011	4820	5763	5172	5318	6104
Deg.-days, season 1936-37, Sept. to June	7888	6353	4976	5753	5246	6266	6738
Deg.-days, Sept. to June, incl., Normal	7466	6290	4703	6155	5398	5874	6384

	Detroit, Mich.	Dodge City, Kan.	Duluth, Minn.	El Paso, Tex.	Erie, Pa.	Evansville, Ind.	Fort Wayne, Ind.
Degree-days for June, 1938	32	1	172	—	34	0	19
Deg.-days, season 1937-38, Sept. to June	6390	4692	9293	2140	6156	4048	6023
Deg.-days, season 1936-37, Sept. to June	6505	5387	9916	2755	6014	4381	6129
Deg.-days, Sept. to June, incl., Normal	6490	5035	9443	2428	6273	4244	5925

	Fort Worth, Tex.	Grand Rapids, Mich.	Green Bay, Wis.	Harrisburg, Pa.	Hartford, Conn.	Indianapolis, Ind.	Ithaca, N. Y.
Degree-days for June, 1938	—	24	49	11	29	6	48
Deg.-days, season 1937-38, Sept. to June	2141	6411	7609	5202	5870	5305	6492
Deg.-days, season 1936-37, Sept. to June	2729	6523	7955	5131	5650	5454	6566
Deg.-days, Sept. to June, incl., Normal	2148	6535	7825	5375	6036	5298	6719

	Kansas City, Mo.	Knoxville, Tenn.	La Crosse, Wis.	Lansing, Mich.	Lincoln, Neb.	Little Rock, Ark.	Los Angeles, Calif.
Degree-days for June, 1938	0	0	17	61	3	0	25
Deg.-days, season 1937-38, Sept. to June	4723	3357	7067	6838	5639	2790	1071
Deg.-days, season 1936-37, Sept. to June	5272	3238	7766	7048	6380	3206	1475
Deg.-days, Sept. to June, incl., Normal	4852	3670	7322	7048	5999	2811	1504

	Louisville, Ky.	Madison, Wis.	Memphis, Tenn.	Milwaukee, Wis.	Minneapolis, Minn.	Nashville, Tenn.	New Haven, Conn.
Degree-days for June, 1938	0	26	—	52	29	0	28
Deg.-days, season 1937-38, Sept. to June	4233	7084	2826	6714	7729	3353	5585
Deg.-days, season 1936-37, Sept. to June	4449	7616	3199	7075	8390	3531	5405
Deg.-days, Sept. to June, incl., Normal	4180	7429	2950	7245	7850	3507	5895

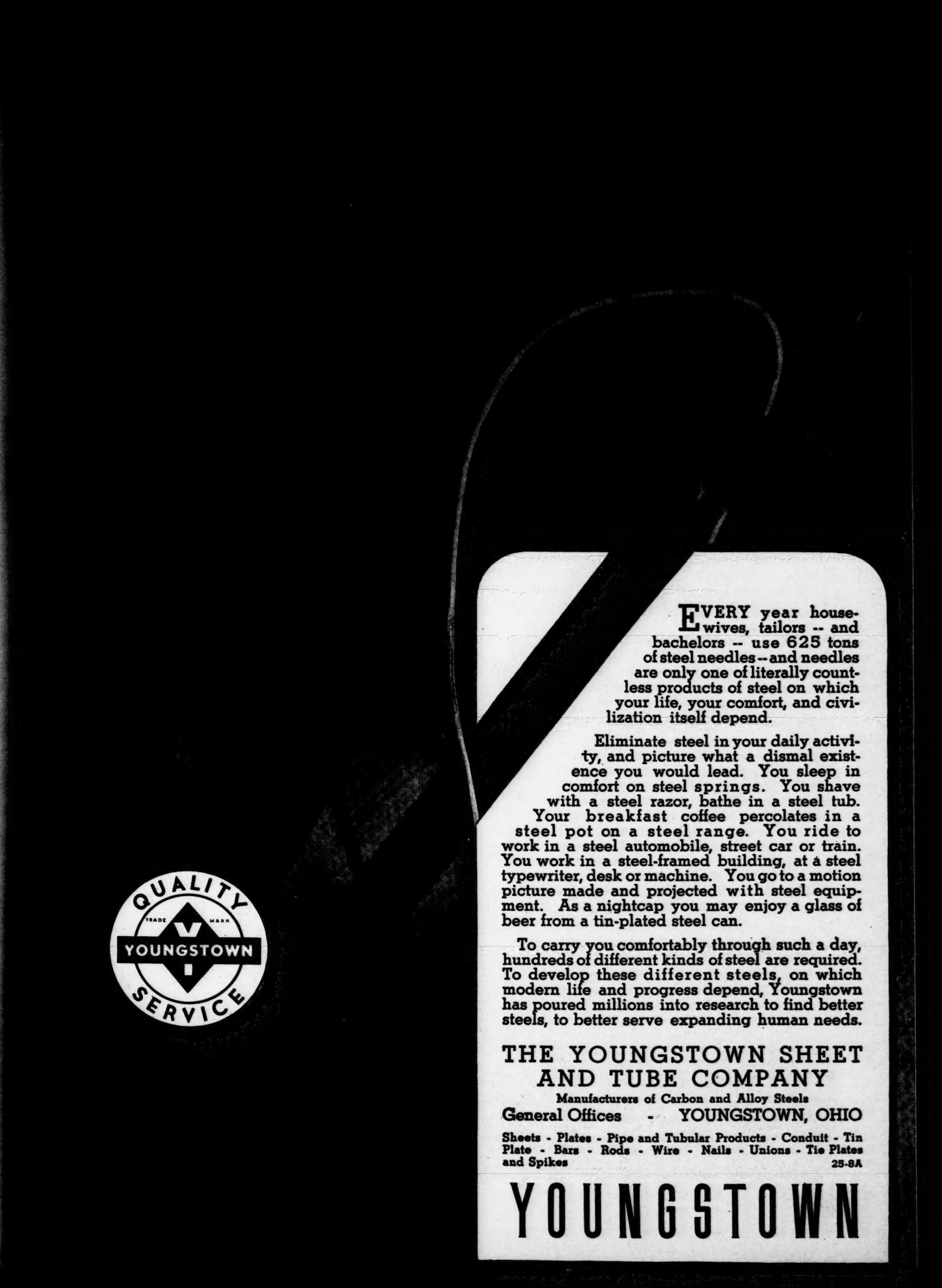
	New Orleans, La.	New York, N. Y.	Norfolk, Va.	Oklahoma City, Okla.	Omaha, Neb.	Peoria, Ill.	Philadelphia, Pa.
Degree-days for June, 1938	0	21	5	0	4	7	12
Deg.-days, season 1937-38, Sept. to June	1204	4976	3196	3447	5946	5681	4668
Deg.-days, season 1936-37, Sept. to June	1087	4857	3066	3990	6772	6025	4541
Deg.-days, Sept. to June, incl., Normal	1024	5347	3350	3613	6131	6109	4855

	Pittsburgh, Pa.	Portland, Me.	Portland, Oreg.	Providence, R. I.	Reading, Pa.	Reno, Nev.	Richmond, Va.
Degree-days for June, 1938	6	82	65	40	13	73	8
Deg.-days, season 1937-38, Sept. to June	5083	6989	3892	5805	4963	5320	3724
Deg.-days, season 1936-37, Sept. to June	5019	6640	4479	5540	4949	6036	3678
Deg.-days, Sept. to June, incl., Normal	5235	7012	4469	6015	5389	5892	3727

	Rochester, N. Y.	St. Louis, Mo.	Salt Lake City, Utah	San Francisco, Calif.	Scranton, Pa.	Seattle, Wash.	Spokane, Wash.
Degree-days for June, 1938	25	0	17	226	30	96	72
Deg.-days, season 1937-38, Sept. to June	6412	4374	4740	2674	5942	4030	5676
Deg.-days, season 1936-37, Sept. to June	6342	4774	6013	2926	5903	4672	6898
Deg.-days, Sept. to June, incl., Normal	6732	4585	5555	2876	6129	4883	6355

	Springfield, Ill.	Syracuse, N. Y.	Toledo, Ohio	Trenton, N. J.	Utica, N. Y.	Washington, D. C.	Wichita, Kan.
Degree-days for June, 1938	1	25	23	17	54	6	0
Deg.-days, season 1937-38, Sept. to June	5081	6268	6023	5077	7002	4263	4392
Deg.-days, season 1936-37, Sept. to June	5427	6246	6152	4966	6538	4207	4997
Deg.-days, Sept. to June, incl., Normal	5373	6893	6077	4933	6796	4626	4673

Methods of applying the degree-day in connection with the operation of heating plants or for the prediction of fuel consumption of heating plants are described fully in the new enlarged edition of the DEGREE-DAY HANDBOOK, published by HEATING & VENTILATING, 148 Lafayette Street, New York, price $3. Degree-days as given above for a "normal" month or season are based on averages for a long period of years, ending about 1922. Averages covering different periods will disagree with the above figures slightly.



EVERY year housewives, tailors -- and bachelors -- use 625 tons of steel needles--and needles are only one of literally countless products of steel on which your life, your comfort, and civilization itself depend.

Eliminate steel in your daily activity, and picture what a dismal existence you would lead. You sleep in comfort on steel springs. You shave with a steel razor, bathe in a steel tub. Your breakfast coffee percolates in a steel pot on a steel range. You ride to work in a steel automobile, street car or train. You work in a steel-framed building, at a steel typewriter, desk or machine. You go to a motion picture made and projected with steel equipment. As a nightcap you may enjoy a glass of beer from a tin-plated steel can.

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SARCO CANADA LIMITED FEDERAL BLDG. TORONTO, ONT

SUMMER DEGREE-HOURS (ABOVE 85F)* JUNE, 1938

City	June, 1938	June, 1937	Year, 1938 to June 30	Year, 1937 to June 30
Baltimore	220	197	226	258
Birmingham	239	951	342	1258
Bismarck	112	206	112	249
Boston	62	51	81	99
Buffalo	0	7	2	7
Chicago	4	128	15	173
Cincinnati	64	121	68	227
Cleveland	8	0	8	7
Columbus	109	48	121	100
Des Moines	233	413	233	427
Detroit	51	1	51	36
Fort Wayne	29	5	30	38
Grand Rapids	39	38	42	89
Houston	517	936	588	1099
Indianapolis	26	44	26	126
Kansas City	264	874	276	939
Memphis	130	532	167	756
Milwaukee	1	80	1	92
Minneapolis	111	113	111	133
New Orleans	610	622	715	820
New York	8	21	8	30
Philadelphia	84	66	85	88
Pittsburgh	4	49	6	67
Portland, Oreg.	45	83	79	83
Richmond, Va.	59	261	105	365
St. Louis	145	431	162	568
San Diego	0	0	0	0
San Francisco	0	1	0	1
Savannah	278	699	845	933
Toledo	51	2	58	38
Washington	209	142	223	211

*Based on data made available through the cooperation of the U. S. Weather Bureau.

WITH THE MANUFACTURERS

Air-Maze Corp., 812 Huron Rd., Cleveland, has appointed *E. B. Treidler* special representative covering southern California and Arizona. He will be associated with the *Harvey L. Laughlin Co.*, 1315 E. 7th St., Los Angeles, recently appointed factory representative for Air-Maze.

B. S. Williams

Airtemp, Inc., Dayton, Ohio, has appointed *B. S. Williams*, recently vice-president and general manager of its New York company, as general sales manager. *R. G. Wyld* has been named vice-president in charge of engineering. Mr. Wyld was formerly executive engineer. *Arthur R. Fors* has been appointed vice-president in charge of manufacturing. Mr. Fors was formerly works manager.

Bell & Gossett Co., Chicago, has appointed *Norman Brown* as its representative in San Francisco and surrounding territory, with headquarters at 637 Minna St., San Francisco.

Century Engineering Corp., Cedar Rapids, Iowa., has opened a factory branch in the General Motors Building, New York. *George Kelly* will be in charge.

Binks Manufacturing Co., 3114-40 Carroll Ave., Chicago, has erected a complete cooling tower test plant on the roof of its new two-story plant extension. An atmospheric cooling tower and forced draft and induced draft type towers are erected on a steel substructure specially designed for this purpose. Various types and sizes of towers will be connected up to circulating pumps for tests comparable to actual operating conditions. Water is heated through a system of cross-connected boilers to any desired temperature and adjacent to the test plant is an instrument panel which automatically records temperatures on and off the tower. Wind velocities, operating pressures and other essential data are also recorded.

A. M. Byers Co., Pittsburgh, Pa., has named *W. J.* Mayer sales engineer. Mr. Mayer was formerly commercial research engineer for Reading Iron Co. He will work out of the company's Philadelphia division office, 1210 Girard Trust Building. His territory will include Baltimore and the south.

The Fox Furnace Co., Elyria, Ohio, has announced that the business and assets of the company have been taken over by American Radiator Company, its sole stockholder. The company will hereafter be called the Fox Furnace Division of American Radiator Company. Existing selling policies will be continued.

General Refractories Co., 1600 Real Estate Trust Building, Philadelphia, has appointed the following distributors: *Slip Not Belting Co.*, Kingsport, Tenn.; *Fleck Co.*. Camden, N. J.; *New England Brick Co.*, Boston, Mass.; *Lusco Brick & Stone Co.*, Kansas City, Kan.

Marsh Tritrol Co., Chicago, has moved to new offices at *600 S. Michigan Ave.* The New York office of the company has been moved to *347 Madison Ave.*

Munn and Steele, Inc., a recently formed New Jersey corporation with offices at 500 Fifth Ave., New York, announces a new line of insulating and refractory products. *William S. Steele*, president of the corporation, was formerly general sales manager of F. E. Schundler & Co. since the commencement of the vermiculite activities of the company. A directorate headed by *John R. Munn* and including *Stanley N. Muirhead*, president of the Zonolite Co., *Robert C. Shields, Dr. N. B. Tooker, Dr. Jos. A. Babor* and *H. Alexander Smith* has been named.

National Radiator Corp., Johnstown, Pa., has named *James Boyd*, Albuquerque, N. Mex., as its representative in Arizona, New Mexico and western Texas. Mr. Boyd for the past four years was a member of the National Radiator sales force in Washington, D. C. He plans to represent other heating equipment manufacturers in that section and will also have an office in El Paso, which will be under his brother's supervision.

Suburban Air Conditioning Corp., Carrier distributor, White Plains, N. Y., has named *Howard J. Rose* manager of sales and development. Mr. Rose was formerly associated with Fitzgibbons Boiler Co., Inc.

ANSWERS TO QUESTIONS ON PAGE 51

1. (4) is correct
2. (2) is correct
3. (4) is correct
4. (5) is correct
5. (3) is correct

RIP VAN WINKLE BOUGHT NO STEAM

RIP sawed wood for 20 years. He slept and snored while the world went on. But YOU can't sleep for 20 years and forget your steam lines underground — unless they're protected by Ric-wiL Conduit. In less than that time, steam lines with insufficient protection will be gone with the wind. Steam itself plus the forces of nature will destroy your investment. A Ric-wiL System, with incomparable Dry-paC Insulation, will allow you to imitate Rip as far as steam lines are concerned.

Ric-wiL Conduit for steam power and heating lines is a sectional system built of vitrified, glazed Tile (also furnished in Cast Iron and in Armco Iron Units). Standard Ric-wiL is insulated with patented Dry-paC Waterproof Asbestos, but loose commercial insulation or sectional pipe covering may be had if desired. Ric-wiL with Dry-paC, as proved by reliable tests, gives over 90% efficiency on the line. Upper and lower halves of Ric-wiL Conduit are interlocked by the Loc-liP cemented joint. End joints of conduit and base drain are staggered—another interlocking feature. Ric-wiL provides adequate drainage and entirely closed construction. Complete service on layout, manufacture, and installation. Write for latest bulletins.

The RIC-WIL Co., Union Trust Bldg., Cleveland, Ohio

New York **San Francisco** **Chicago**

Agents in principal cities

● Ric-wiL's 28 years experience is really underground steam INSURANCE— costs you NOTHING!

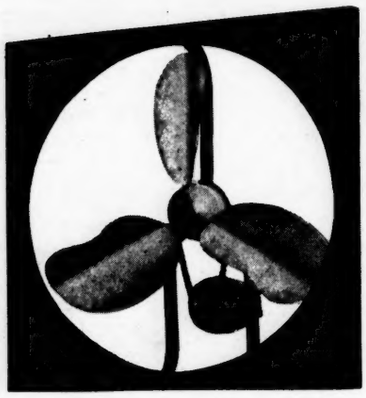
RIC-WIL Type F Conduit

REGISTERED IN U. S. PATENT OFFICE

RIC-WIL

CONDUIT SYSTEMS FOR UNDERGROUND STEAM PIPES

This is the fan only. Ain't any other made like it, er as good.



Hank

Sez:—

As How You Can Turn Folks Sleep Into Money

What's on my mind, is a helping you to get more warm weather business. Some you never had before and never could get. Couldn't, because there wuz nuthin' good enough, and low enuff in price.

To get down to tacks—what I mean is the Burnham Attic Cooler. Not just a fan. But a complete outfit all set for a quick, easy installation, that will pull the very gizzard out of hot sleeping rooms, so that folks can rest without tumble tossing and being madder 'n the devil next day.

Besides selling folks a sleep comfort contrapshun, it keeps the hull house cooler by day, so those who has to stay home, are glad they had to.

There's a lot of fellers who tell us of the nice piece of extra money they are making putting in these Attic Coolers.

Some of 'em, suspect are telling the truth. Just thot I'd tell you so if you wuzzent makin' quite all the money you want, you could make some more, and stop yer frettin'.

Send at once for the Attic Cooler circular telling all you need to know, and maybe even more yet, which extra won't hurt you any. August is the harvest month for these coolers. So get busy.

Hank Hindle

BURNHAM BOILER CORPORATION
Manufacturers of Heating Equipment Since 1873
Irvington, New York **Zanesville, Ohio**
Export Department
50 Church St., New York City

Burnham Boiler

COMING EVENTS

SEPTEMBER 21-23, 1938. 16th Annual Conference, National Industrial Advertisers Association, Cleveland, Ohio. Stanley Knisely, Advertising Manager, Republic Steel Corp., Cleveland, Ohio.

DECEMBER 5-10, 1938. 13th National Exposition of Power and Mechanical Engineering, Grand Central Palace, New York.

JANUARY 23-27, 1939—Annual Meeting, American Society of Heating and Ventilating Engineers, Pittsburgh, Pa.

NEW TRADE LITERATURE

Air Conditioning. A standard-size, 64-page catalog entitled "Peerless Air Conditioning Products," 1938 catalogue. Contains complete description, sales, and engineering data on the new Peerless high dispersion heat transfer surface, as well as information on comfort conditioners, floor type units, ceiling type units, direct expansion coils, water coils for both heating and cooling, steam coils, and other allied products such as thermal expansion valves, evaporative condensers, and heat exchangers. All necessary tables and charts for figuring any air conditioning installation and selecting the proper Peerless coil are included. PEERLESS OF AMERICA, INC., 515 W. 35TH ST., CHICAGO, ILL. 1

Ash Pits. A four-page standard size bulletin, No. M-2, featuring materials, labor estimates and construction details for ash pits and ash-can receivers. This bulletin gives detailed instructions regarding the design and construction of pits in a range of capacities from 3 to 10 tons of ashes. Details are also given for construction of ash-can receivers in ten sizes ranging in capacity from ½ to 3 bushels. Types of constructions covered include pits of concrete masonry, conversion jobs, waterproof concrete, brick masonry and prefabricated steel. ANTHRACITE INDUSTRIES INC., 3207 CHRYSLER BUILDING, NEW YORK. 2

TO OBTAIN COPIES OF TRADE LITERATURE listed in this issue, without charge, circle on the list below the publications wanted, using the identifying item number at the end of each review; fill in your name and address, detach and mail to

HEATING & VENTILATING
148 Lafayette St.,
New York, N. Y.

1 2 3 4 5 6 7 8 9

Name .....

Title .....

Firm .....

Business Address .....

City and State 8/38

Check Valves. A standard-size, 8-page 2-color booklet entitled "Checking Up on Check Valves," covering the whole check valve field in word, picture and diagram. The two basic types of check valves are described, their various applications are discussed, ten "Do's and Don'ts" are listed and two pages are devoted to cross-section views in what is called a "Handy Reference Guide to Crane Check Valves." CRANE CO., 836 SOUTH MICHIGAN AVE., CHICAGO, ILL. 3

Furnaces. Eight-page folder describing the E. K. Campbell large public building heavy duty furnaces. The bulletin describes the principles on which the design and construction of the E. K. Campbell furnace is based and shows how they are applied. E. K. CAMPBELL HEATING CO., 2441 CHARLOTTE ST., KANSAS CITY, MO. 4

Oil Burner Nozzles. A bulletin featuring Balloffet oil burner nozzles. Contains information of interest to burner manufacturers and dealers, together with illustrations and capacity tables. BALLOFFET DIE & NOZZLE CO., INC., GUTTENBERG, N. J. 5

Prefabricated Ducts. Two booklets designed to give practical aid in the work of installing prefabricated duct and fittings. The first is a 20-page booklet, Series 600 installation manual which explains how to assemble and install Lamneck prefabricated duct in air distribution systems. Each step is explained and illustrated. Booklet is intended to be a practical installation guide to those workmen who are not familiar with modern duct and fitting installation practice and also to help experienced installers by presenting methods of saving time and by suggesting practical solutions to difficult installation problems. The second is an eight-page bulletin entitled "Lam-O-Graph" which presents a short cut method of estimating approximate dealer prices on ducts when quick action is necessary. LAMNECK PRODUCTS, INC., 416 DUBLIN AVE., COLUMBUS, OHIO. 6

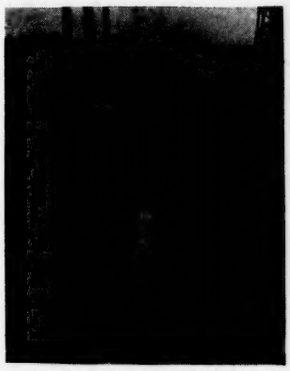
Speed Control Equipment. A 124-page catalog, No. G-384, covering the complete line of Reeves variable speed control equipment. Booklet describes the construction of variable speed transmissions, variable speed motor pulleys, and the Motodrive. Book is bound in a heavy weight black cover and has more than 200 illustrations. Twelve pages are devoted to illustrations of installations, 23 to engineering data on Reeves transmission, 11 to engineering data on Vari-Speed motor pulley, and 19 for the Motodrive. REEVES PULLEY CO., COLUMBUS, IND. 7

Welding Electrodes. A standard-size, 28-page bulletin R-5, giving complete information and data on Smootharc welding electrodes. This bulletin is designed to be a manual on welding electrode information and includes spar tests, procedure sheets and many informative suggestions to make it a useful reference book to all welder users and operators. HARNISCHFEGER CORP., 4400 W. NATIONAL AVE., MILWAUKEE, WIS. 8

Welded Fittings. A standard-size, four-page bulletin, No. WT28, describing Bonney WeldOlets and ThredOlets. Bulletin describes these drop-forged fittings and also discusses their advantages. Includes tables of sizes which are available from stock, dimension, weights and list prices. BONNEY FORGE & TOOL WORKS, ALLENTOWN, PA. 9

ADSCO-BANNON CONDUIT
TILE CONDUIT FOR UNDERGROUND LINES

A Typical Installation



15" ADSCO-Bannon Tile Conduit with ADSCO-Corning Glass Filler Insulation recently installed by a midwestern public utility company.

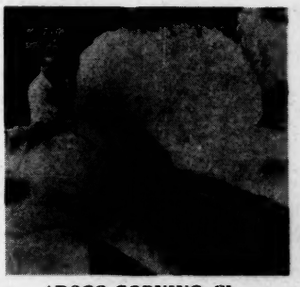
Sturdy Conduit, Durable Insulation Available for Prompt Delivery at a Reasonable Price

ADSCO-Bannon Tile Conduit in combination with ADSCO-Corning Glass Filler Insulation is winning new friends daily among leading colleges, institutions and industrials as a reasonably priced, efficient type of installation for underground steam or hot water lines.

ADSCO-Corning Glass Filler Insulation is exceptionally light weight, easy to install and is one of the most efficient insulating materials on the market. Naturally, being glass, it is not affected by water.

Both products are described in Bulletin No. 35-67V, available upon request. Submit details of your next installation for prompt quotation.

ADSCO-BANNON Tile Conduit



ADSCO-CORNING Glass Filler Insulation

AMERICAN DISTRICT STEAM COMPANY
NORTH TONAWANDA N.Y.
IN BUSINESS OVER SIXTY YEARS

"If I were an ADVERTISING MANAGER"•

That's just one of the talks to be delivered anonymously by a masked speaker that will set every man thinking at the Annual Conference of National Industrial Advertisers Association in Cleveland, September 21-23. A second masked speaker will tell what he would do if he were a publication representative.

We're not going to tell you much here—just highlight the program enough to make your mouth water and your brain tingle.

T. M. Girdler, Chairman, Republic Steel Corporation, is scheduled for the opening address and when "T. M." talks he says something.

J. H. McGraw, Jr. will talk on "What I Would Do *Now* If I Were An Industrial Advertising Manager."

The new Publisher's Statement will receive full discussion.

Clinic sessions, so popular last year, will again cover a wide range of interesting subjects. Two half-day sessions instead of one.

A general conference session will cover such subjects as "Preparing the Plan", "How to Gather Usable Material", "Copy Technique", "How to Sell Management", "Co-ordinating Sales and Advertising" and "How and Why to Use an Industrial Agency."

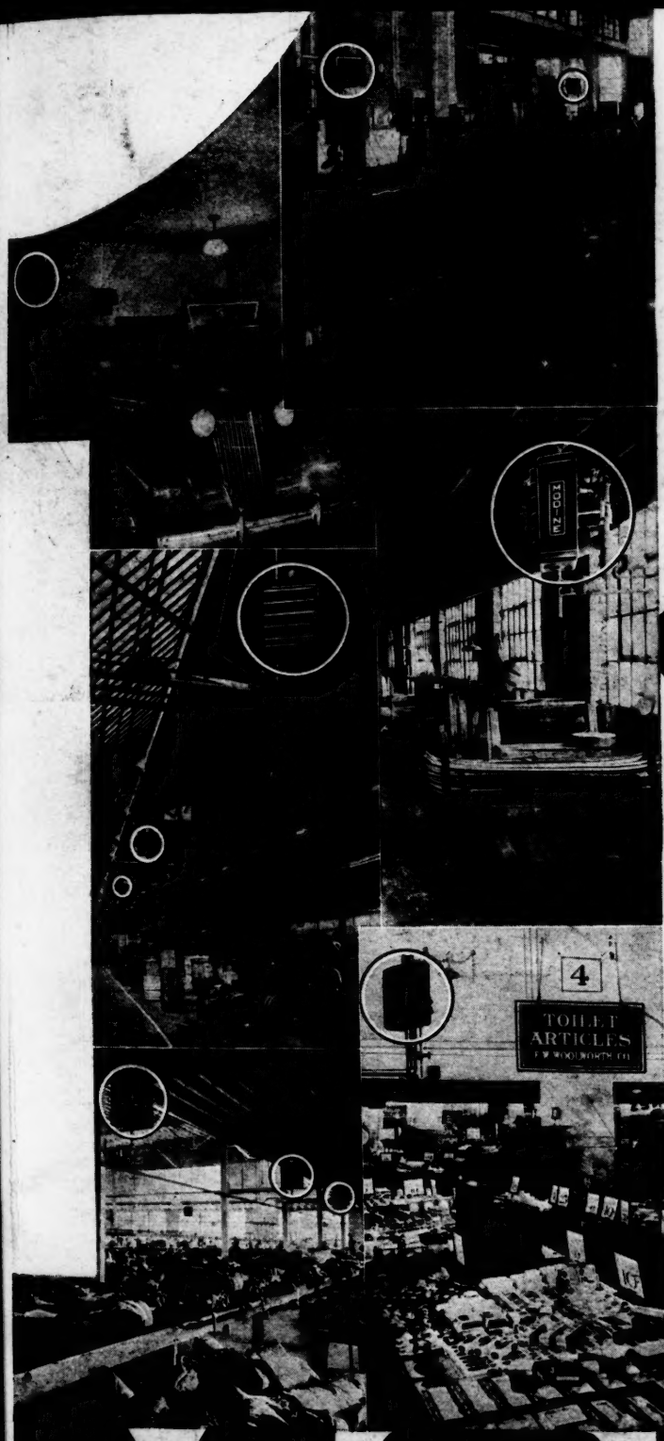
Another session will deal with "Problems of the Small Advertiser", "Production Problems", "Public Relations"—and there are many others.

If I were an Advertising Manager, I certainly would start now to make plans to attend the 16th N. I. A. A. Conference even if I had to hitch-hike to Cleveland. And I would send in my advance registration now to—Ed. Bossart, Bailey Meter Company, Ivanhoe Road, Cleveland, Ohio.

IF I EMPLOYED AN ADVERTISING MANAGER—I would make certain that he attended this Conference, because changing times and markets demand a changed viewpoint—a new viewpoint that can be obtained only by hearing discussions by men whose experience is up-to-the-minute—right up to September 21st.

NATIONAL INDUSTRIAL ADVERTISERS ASSOCIATION

100 EAST OHIO STREET • CHICAGO, ILLINOIS



In First Place

MODINES ARE AT THE TOP AGAIN

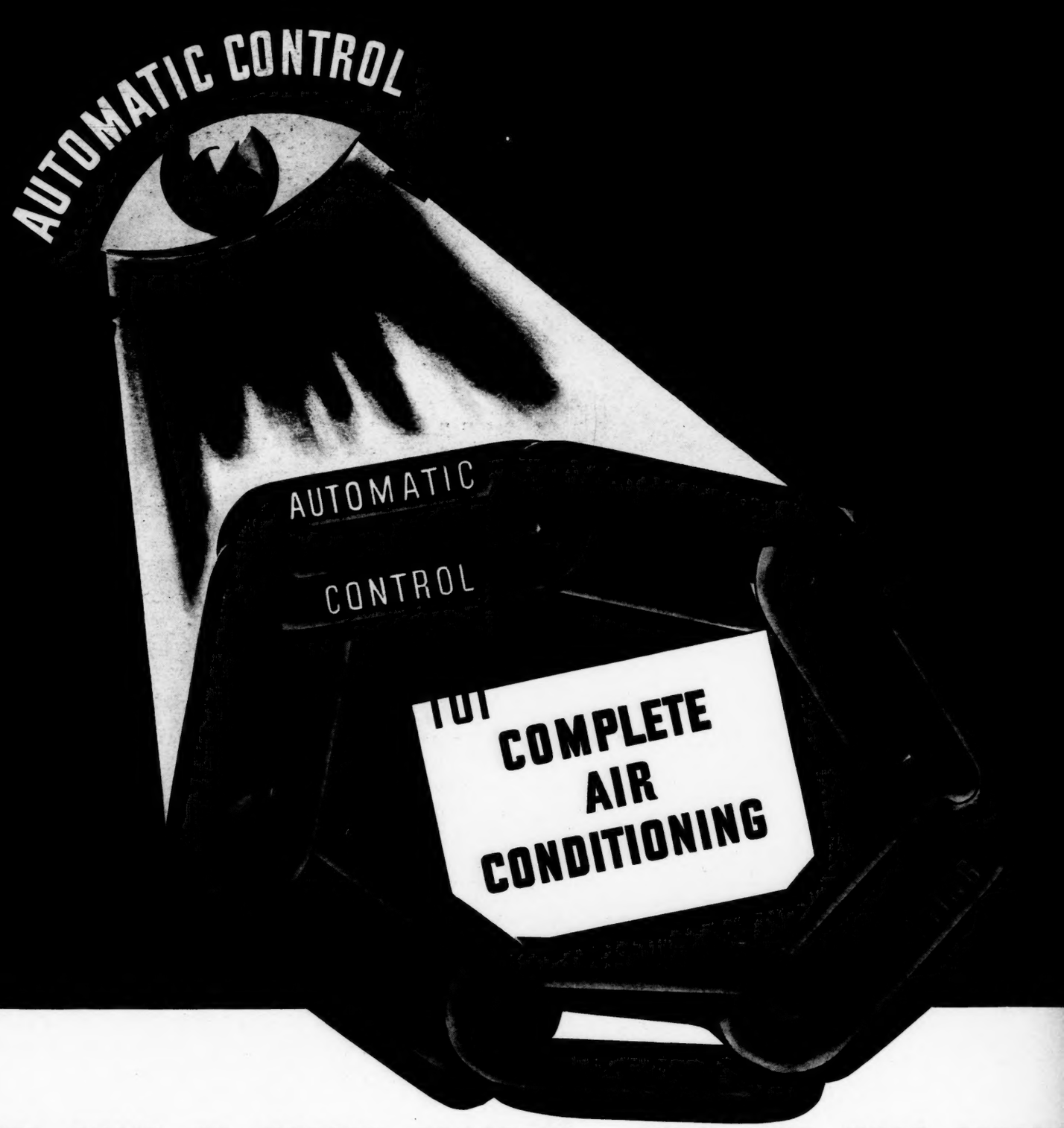
...in previous years...Modine Unit Heaters are easily maintaining their leadership. And for the same reasons. Modines are still the best buy in unit heaters. They do a better, faster and more even job of heating...cost far less to install...are more economical to operate...and they're better looking units, too.

Because Modines are a better buy...they are easier for you to sell. One Modine job sells another. And you have the expert sales and engineering assistance of Modine field representatives, trained in all phases of heating and ventilating. Modines are more profitable to sell because Modine performance keeps them sold... trouble calls and servicing don't eat up your profits.

Backed by the extensive facilities, equipment, experience and organization of a pioneer unit heater manufacturer financially rated at over a million dollars, Modine Unit Heaters will continue to lead the field. *Write* for new Catalog 138, *Modine Manufacturing Company, 1202 17th St., Racine, Wisconsin.*

This advertisement appeared in the September, 1936, issue of Heating & Ventilating...and is reprinted in full because Modine Unit Heaters still lead the field.

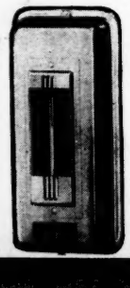
MODINE



THE CHAIN OF MODERN PRACTICE . . . EACH LINK MUST FUNCTIO WITH CONTROLLED EXACTNESS —

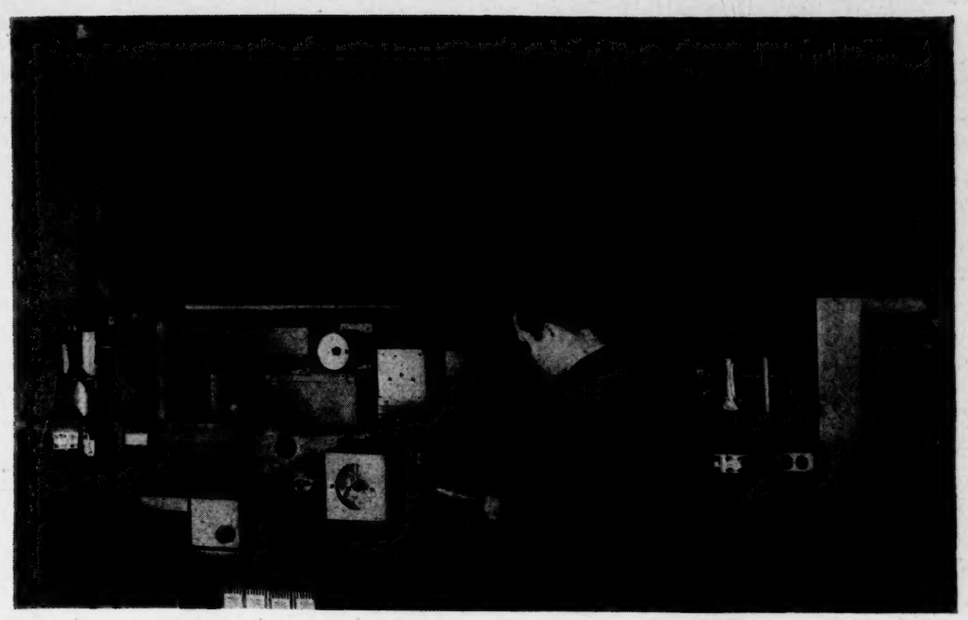
Successful 7-point (year-'round) air conditioning depends upon careful inter-weaving of the various elements. When the automatic control link in the complete system is "by Johnson," engineer, air conditioning manufacturer, contractor, and owner are sure that one important element is in proper hands. The Johnson organization is unique in its field. Research, design, and manufacturing at Milwaukee are founded on more than fifty years of experience in automatic temperature control, reinforced by more than thirty direct branch offices in the United States and Canada. Those branches are manned by sales engineers and technicians, especially trained for this highly specialized work, and, in turn, reinforced by expe enced installation and service men stationed in more th 200 different cities.

Ask for a special set of bulletins which describe and illustr Johnson apparatus for automatic temperature and air con tioning control. Get complete details on recent Johnson dev opments, such as the proportioning damper, pilot opera damper motors and valves, the membrane humidostat, the modulating attachment for thermostatic expansion val Or, better yet, ask a Johnson engineer, from a nearby bra to call and discuss your problems.



JOHNSON SERVICE COMPA

MILWAUKEE, WIS., AND DIRECT BRANCH OFFICES IN PRINCIPAL



Electrical apparatus used by the Department of Terrestrial Magnetism of the Carnegie Institution of Washington to give a continuous record of the large-ion content of the air.

Effect of People on Ion Content of the Air

By DR. G. R. WAIT†

Suspended in the atmosphere are minute particles of matter which perform extremely useful functions — condensation-nuclei, around which form droplets of clouds and fog, and without which the humidity of the atmosphere would rise to unbearable proportions. Similar particles are given off by human beings through exhalation, each person expelling about three billion per minute. Nearly half of them carry a positive electric charge, an equal number carry a negative charge, while the remainder carry no charge. These particles tend to accumulate in a close room where people congregate. When people smoke other particles are created differing in character from the particles that are contained in the breath. The particles of smoke are produced at a rate about 35 times as fast as those of the breath. The total number of minute particles in the air of a closed building occupied during a portion of the day only, varies with the time and degree of occupancy. The number increases when the building is occupied and diminishes when it is unoccupied. Dr. Wait has been studying these particles for several years, and in this article he tells the results of his investigations.

NUMEROUS small, invisible particles of matter are in the air about us that perform extremely useful functions. Were they absent from the air, life as we know it today would be well nigh impossible. They exist entirely unobserved and their presence can be detected only by means of especially designed apparatus. These particles associate themselves with the water in the atmosphere, thus producing clouds which, in turn, enable the rain to fall and make fertile the fields from which man derives his sustenance.

As the heat from the sun falls upon the earth, moisture is evaporated from its surface. With continued heating, more and more water-vapor is added to the air. If the air becomes cooled, all this water cannot remain as invisible vapor but must condense into its liquid form. But molecules of vapor do not combine with each other directly to form a liquid droplet; some particle of matter must be present around which they may combine if the point of saturation for water-vapor is not to be greatly exceeded. Fortunately sufficiently large numbers of small minute particles of matter are always present in the atmosphere to allow condensation to take place and thus to keep the air from becoming too humid.

The particles of matter around which the water-vapor of the atmosphere collects are frequently referred to as "dust-particles." This is misleading. They are quite distinct from the small particles of dirt such as make up the clouds of dust originating in a middle west "dust-bowl" or the small whirls which appear on streets on windy days. Such dust-particles do not readily act as centers around which water-vapor may collect. The

†Department of Terrestrial Magnetism, Carnegie Institution of Washington.

particles which serve as centers about which water-vapor may condense are many times smaller than true dust-particles. Because they act readily as centers of condensation for water-vapor, they are called "condensation-nuclei."

Origin of Condensation-Nuclei

The condensation-nuclei of the atmosphere owe their origin to many different sources. The burning of most materials gives rise to great numbers of these small particles. The number of particles in the vicinity of thickly populated communities and in regions of much commercial activity, such as manufacturing plants, is usually greater than in other localities. In some regions an appreciable number of the condensation-nuclei are minute salt-particles originating in the waters of the ocean. John Aitken, a famous scientific investigator of Scotland, who pioneered in this field a half century ago, called attention to the ocean as a source of condensation-nuclei.

Commenting on this origin, he wrote: "One source of the supply of this salt-dust is evidently the ocean."

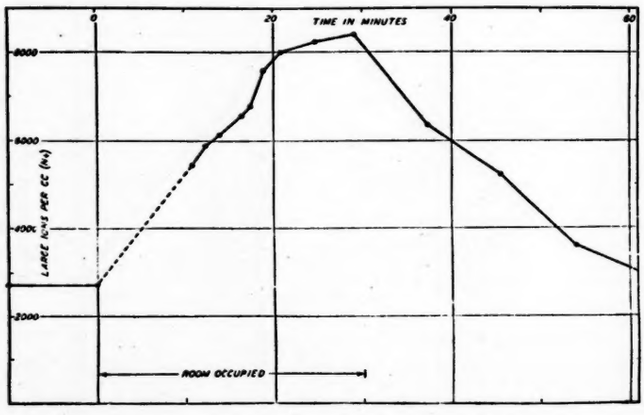
Aitken, however, devised a method of counting these nuclei and constructed a small portable apparatus for determining their number in different localities.

An Aitken nuclei-counter has been used to examine the air in and about Washington, D. C., for condensation-nuclei. In general, the number in the air in the vicinity of the city greatly exceeds that in the outlying districts in the country. The number of nuclei varies, also, with time of day. They are most numerous when the fires in furnaces are most active and are sending the greatest amount of smoke into the air.

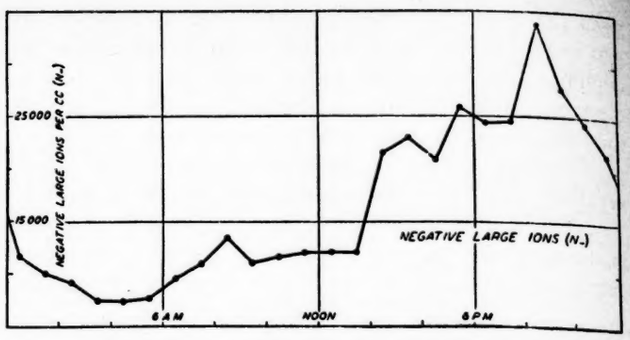
From the close agreement between the variation in the number of nuclei and the variation in the amount of smoke that must be getting into the air, it has been concluded that the major portion of the condensation-nuclei in the air of Washington during winter owe their origin to the heating plants of the city. Records of the United States Public Health Service show that the number of nuclei in the air is considerably greater near industrial cities than near cities with few industries.

Number Inside and Outside Buildings

A comparison has been made between the number of condensation-nuclei inside of buildings and the number outside. The number inside a building was found



Positive large ions in closed room before, during, and after occupancy by ten persons for thirty minutes.



Negative large ions recorded in a building with no people present from 11 p.m. to 8 a.m., about 50 people from 8 a.m. to 2 p.m., and about 500 people from 2 p.m. to 11 p.m.

to depend largely upon various circumstances but particularly on whether or not the building is occupied.

The condensation-nuclei were determined in a closed room before it was occupied by people and found to total 1362 billion. Six people then entered the room, and the doors and windows were kept closed. After 30 minutes the condensation-nuclei had increased in number to 1956 billion.

Other tests of rooms before and after they were occupied by people showed without exception that occupancy increased the number of nuclei in the room.

A test extending over two hours and another over eight hours were made with one person in a sleeping-room. The number of nuclei in the room at the beginning of occupancy was 720 billion. At the end of two hours it was 1072 billion, and at the end of eight hours it was 2053 billion. Assuming that the people in the rooms produced the additional nuclei, each person must have given out about three billion nuclei each minute.

Other tests indicated that the majority of the condensation-nuclei of human origin come from the breath. Since normally we breathe about 15 times per minute, each breath must contain about 200 million condensation-nuclei. A small number of nuclei appear to come also from other parts of the body. The exact origin and character of these nuclei, either from the breath or from the body, has never been investigated and little is known concerning them.

The majority of the condensation-nuclei from the breath come into the outside air with an electric charge and, therefore, are called ions. Half of these ions are positively charged and the other half are negatively charged. Ions in the air fall into two general classes—large and small ions. Ions of the breath belong in the first of these classes. The large ions given off by people are capable of being counted by a suitable electrical apparatus. Such an ion-counter, giving a continuous record of the large-ion content of the air, has been developed at the department of terrestrial magnetism of the Carnegie Institution of Washington.

Counting Ions

With the ion-counter installed in the laboratory, a study was made of the effect of occupancy on the large positive-ion content of a closed room. Before the room was occupied, the number of large positive ions in the room was 170 billion and remained constant so long as the room was not occupied. When ten people en-

tered the room, the record shows that the number of ions began to increase gradually until, at the end of 30 minutes, there were 520 billion large positive ions in the room. The average contribution per person during each minute in the room must have been 1.17 billion.

A similar experiment was carried out on the large negative ions. The results showed that they also increased when people occupied the room. The increase in this case was at the rate of 1.14 billion per person during each minute the room was occupied. These tests show that people give off large ions, positive and negative about equal in number, to the extent of something over two billion per minute. After the room was vacated, the number of large ions gradually diminished, and in 30 minutes the number was only slightly greater than before the room was occupied.

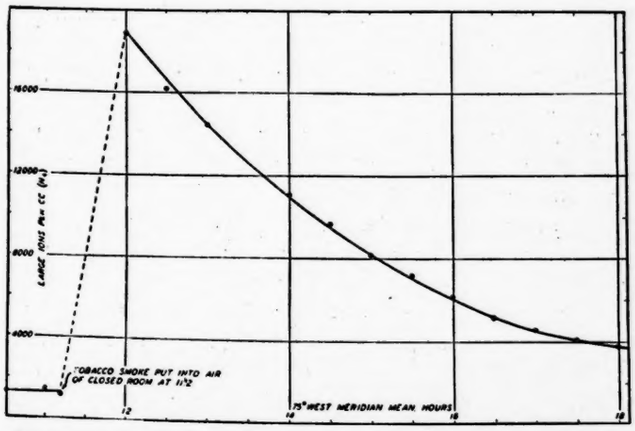
The process by which the number of large ions was eventually reduced must have been acting during the time the room was occupied as well as after it ceased to be occupied. Taking this process into consideration, it appears that some four and one-half billion large ions of the two signs are given up by the human system per minute.

This number is nearly 50% greater than the total number of condensation-nuclei found, with the Aitken counter, to come from the human system. It is possible that this difference may be attributed to experimental errors. On the other hand, there is a possibility that the difference may indicate that some of the particles given off by the human system, while they can become electrically charged and consequently are large ions, do not act as centers for the condensation of water-vapor.

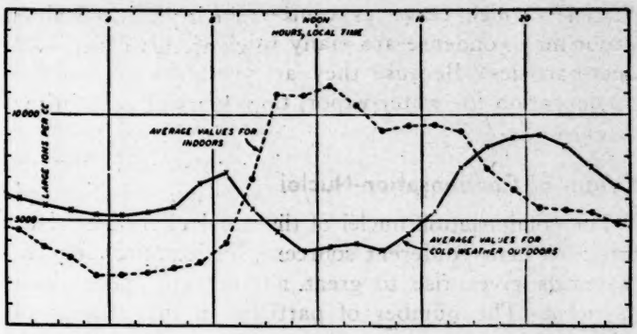
Effect of a Large Group

Opportunity was taken on one occasion to test the effect of a large number of people assembled in a building on the large-ion content of the air in one of the rooms of the building. The test was made during one of the annual exhibitions of the Carnegie Institution of Washington.

The large-ion counter was installed in one of the exhibit-rooms and recorded the ion-content of the air throughout the three days of the exhibition. The exhibition was open to the public each day from 2 to 5:30 p.m. and from 7:30 to 10:30 p.m. The building was occupied by exhibitors and by regular employes of the Institution at other hours of the day. The large-ion content of the air of the building showed a decided response to changes in the number of occupants.



Smoking in a closed room for 22 min. increased the number of large ions from 1200 to 19,000 per cubic centimeter; after the smoking had ceased the number of large ions in the room gradually diminished, but even after 12 hr. the number in the room was still 50% more than before the smoking occurred.



Variations during day in number of large ions on work-day in mid-week, indoors and outdoors at Washington, D. C. During working hours large ions were more concentrated indoors than outdoors, while during non-working hours they were less concentrated indoors.

From midnight to about 8 a.m., when the building was not occupied, the number of large ions in the air fell to a low minimum.

From 8 a.m. to 2 p.m., when only regular employes and exhibitors were present in the building, the number of large ions increased by about 30%. During the afternoon, from 2 p.m., when there were, on the average, about 500 people in the building, the number of large ions in the air more than doubled. After the exhibit closed at night, the number of large ions gradually diminished to lower values.

In general, the number of people in the building gradually decreased after about 9 p.m., while the greatest number was in the building immediately following the opening of the exhibit at 7:30 p.m. The large-ion content of the air in the building responded to even these details—the record obtained with the counter could almost be taken as a record of attendance at the exhibit.

The Effect of Smoking

Appropriate experiments were conducted to investigate the effect of smoking. A record of the number of large ions in a closed room was secured before and after tobacco was smoked. Smoking one pipeful of tobacco and three cigarettes during 22 minutes caused the large ions of one sign in the room to increase from 76 billion to over 1700 billion. After the smoking ceased the large ions gradually diminished in number until at the end of 12 hours there were only 100 billion left, or about 50% more than before the smoking occurred. The diminution in the number of large ions was due, no doubt, to a combination of circumstances, prominent among them being ventilation through various small openings and the falling out of the ions under the force of gravity.

Smoking in a room, it was found, contributes to both the positive and negative large ions in about equal proportions. On this basis the rate at which both positive and negative large ions increased in number was about 160 billion per minute, or around 20 billion per puff.

One pipeful of tobacco, when smoked, produced about 2600 billion large ions and three cigarettes contributed around 800 billion.

A moderate rate of smoking produces about 35 times as many large ions as are produced by breathing alone. Thus one individual smoking in a more or less casual manner will produce as many large ions as 35 people who are not smoking. The chemical character of the minute particles composing the large ions probably differs greatly in the two cases.

Ions and Ventilation

A record of the large ions in a closed room may be taken as an index of the conditions of the air with respect to the degree of ventilation. A picture of the condition with respect to ventilation was secured by continuously recording the number of large ions in a room of the main building of the department of terrestrial magnetism in Washington. The condition in this building may be regarded as more or less typical of many offices, as it was occupied during the usual working hours of the day and remained unoccupied during Saturday afternoon and Sunday.

The records show that the large ions increased in number when the building became occupied and diminished again after the building ceased to be occupied, so that the number was high during the day and low during the night. It gradually increased from Monday morning to Saturday afternoon, and diminished from Saturday afternoon to Monday morning. The average number of large ions of one sign during the working hours on Monday was 7200 per cubic centimeter, while the average number for the corresponding hours of Wednesday was 8600 per cubic centimeter. For the same period on Saturday the average number had risen to 9600 per cubic centimeter, but for that period on Sunday the average number had dropped to 3300 per cubic centimeter.

During these experiments no one was smoking in the room containing the apparatus, but several persons were smoking in other rooms of the building. During most of the time the experiments were in progress all windows and doors of the room were kept closed and no forced ventilation was used. Since windows are frequently opened in order to increase ventilation, some special tests were made to determine the effect of keeping windows of the room open on the number of large ions in the room.

Opening two windows in the room where the apparatus was in operation resulted in a lowering of the number of large ions in the room. Upon closing the windows the large ions increased in number to approximately that prevailing before the windows were opened. The average number of large ions of one sign in the room just before opening and soon after closing the windows was eleven billion, while the average number with the windows open was seven billion. Apparently then the ventilation through the open windows reduced the number of large ions in the room by about one-third.

Effect of Varying Conditions

The change in the number of large ions when windows are opened depends, of course, on the relative amounts of this kind of pollution indoors and outside. Out-of-doors the amount of pollution of this type varies considerably with time of day, being greatest in the evening and least in the middle of the day. In winter there are actually twice as many large ions in the outside air of Washington during the evening as there are around midday.

Indoors, in a room occupied only during working hours, the number of large ions varies in an opposite way, being greatest in the day and least in the evening and at night. Thus there are, during working hours, relatively more products of pollution indoors than outdoors.

During the evening and early morning, however, the reverse is the case. Opening a window for ventilation during the day may, therefore, reduce the large-ion content of the room, but in the evening or early morning it may cause the ion-content indoors to be increased. This may be seen from the accompanying illustration, where the dotted curve shows the change indoors through a work-day during midweek and the unbroken curve the change outdoors in large-ion count on a winter day. Reference to these curves shows that only between 9 a.m. and 6 p.m. could one get a reduction in the number of large ions in the room by ventilation through an open window.

The pollution inside a building, however, as a whole, probably will differ in character from that in the outside atmosphere. A large part of the pollution in the outside atmosphere apparently originates through domestic fires in the vicinity. This appears likely from a consideration of the number of large ions present at any time together with the probable rate at which they disappear.

Results Harmful and Beneficial

The presence of pollution-particles in the atmosphere is undesirable from many points of view. The breathing of these products may be harmful to the human system. While the larger particles making up this pollution will tend to be filtered from the air before it reaches the lungs, many of the smaller particles, such as the condensation-nuclei, will be taken directly into the lungs. To what extent these may prove harmful is not known. In a city one breathes approximately 300 million of these small particles during each minute. A person residing in the country may fare somewhat better in this respect, but even he may breathe into his lungs a tenth of this number.

The condensation-nuclei in the atmosphere tend to reduce the amount of ultra-violet light received from the sun. These nuclei are most numerous during the winter and thus are most effective in screening off these rays at the time of the year when they are the weakest. The screening effect of nuclei for ultra-violet light is still further enhanced through their association with the water-vapor in the air. The increased screening is brought about through an increase in size of the condensation-nuclei when they absorb moisture from the air. This very characteristic, however, makes the condensation-nuclei play a beneficial role for mankind. They are the conditioners of the atmosphere, preventing the air from becoming too moist—indeed, we may owe our very existence to them.

UNIT HEATERS

CONTENTS

Improved Appearance for Unit Heaters 30
Unit Heater Motors 31
Unit Heaters Pay Their Way in Modernizing 32
Engineering is Important in Unit Application. 33
Unit Heaters with Hot Water Systems 34
Automatic Controls Insure Satisfactory Performance . . . 36
Using the Unit Heater for Preventing Building Condensation . 38
The Other Side of Unit Heating 40
Association Adopts Standards for Propeller Type Heaters . . 42
Electric Unit Heaters 43
The Gas-Fired Unit Heater 44
The Word is Versatility! 46
Steam Piping Connections for Unit Heaters 48
They Must Be Silent 51

Photo courtesy Perfex Corporation.

Improved Appearance for Unit Heaters

By M. F. MAY†

WHEN unit heaters first started to become popular some twelve or thirteen years ago, most engineers, contractors, and building owners were more interested in the mechanical construction of the units and the way they would perform, than in their appearance. The main reason that appearance was unimportant can be easily accounted for by the fact that nearly all installations at that time were made in industrial buildings where the surroundings were such that the unit heaters were hardly noticed except from a performance standpoint.

The heating results obtained from these early installations were so superior to the results given by older methods that the use of unit heaters spread to garages, filling stations, gymnasiums, stores, and other similar buildings. These latter types of buildings called for unit heaters that were better looking than the early rough factory units. As a result, most manufacturers met this need by making a more finished looking product that was satisfactory for these installations.

Unit heater manufacturers then began to realize there was a large field for their product if they would develop units that were quiet in operation and attractive in appearance. Several years ago a few manufacturers started to redesign their units, paying particular attention to sound ratings and appearance. Since then practically all manufacturers have put out equipment following this same general procedure.

A typical unit heater of the earlier days is shown in Fig. 1. This unit consisted of a heating element with fan, motor, louvers to direct the flow of air, and the simplest kind of a casing. Rough castings in direct contact with the steam were exposed on the outside of some heaters. As only an ordinary shop coat of paint was used as a finish, this paint would burn and discolor making rather an unsightly appearance. The sheet metal casing was used only to support the heating element, fan shroud and motor, and on most units was made with square corners, with raw edges exposed, and with no extra finishing touches of any kind. These earlier unit heaters, while rather crude and unfinished in appearance, did heat efficiently and it was their performance that brought about their popularity.

†Vice-President, Young Radiator Co.

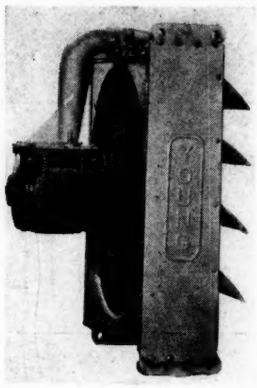
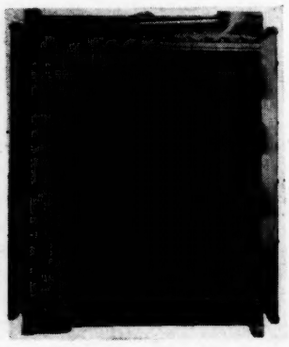


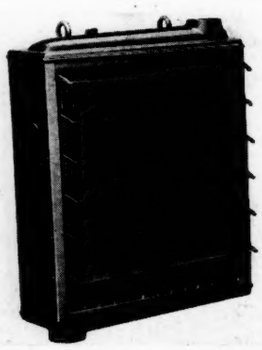
Fig. 4 (Left). Side view of an early unit heater. Fig. 5 (Right). Cross-sectional view of a modern unit heater.

Fig. 2 illustrates an early attempt to improve the appearance. The raw edges on the casing were covered and a heat resisting paint was used which would not discolor from ordinary steam temperatures. The casings were still narrow on many units, leaving the motor completely exposed, and while improved in appearance, these units still were not suitable for installation where an attractive heater was required.

Practically all manufacturers of unit heaters today realize that appearance means just about as much as performance. Fig. 3 illustrates the appearance of a typical unit heater as manufactured today for use in industrial buildings, garages, Sunday school rooms, recreation rooms, lodge halls, and any other type of building where quick and efficient heating is required. Most unit heaters of today have well built sheet metal casings with rounded corners. The casings of many units are deep enough to completely enclose the fan and fan shroud, and even partially conceal the motor. A good illustration of this is shown in Fig. 5. Most of the present-day unit heaters have baked enamel finish and many have an attractive chrome trim.

By recognizing the trend of modern heating, the manufacturers of unit heaters have kept pace with the times and opened new fields for unit heaters which are being installed in many places today where just from an appearance standpoint the old type units could not have been used.





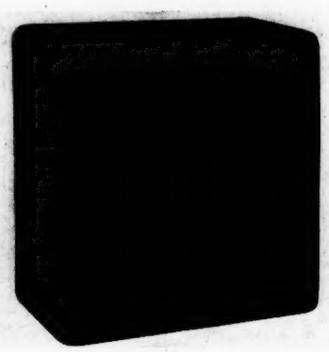


Fig. 1 (Left). An early type unit heater where no attempt was made to improve the appearance. Fig. 2 (Center). An early attempt to improve the appearance. Fig. 3 (Right). A modern unit heater with baked enamel finish.

Unit Heater Motors

By EDMUND R. WALKER†

AXIOMATICALLY, the unit heater's functions are to heat and deliver air. Functionally, rapid air movement through the unit heater is necessary for satisfactory operation. First, as the means of enormously accelerating the transfer of heat from the heating element to the air; second, as the means of projecting the heated air 20, 50, 100 feet—even farther—away. The generally accepted means of propelling the air through and away from the unit heater is by a motor-driven fan.

Propeller Fan Unit Heater Motors

The relationship of a motor and propeller fan mounted on the motor shaft is so intimate that the motor should be designed to conform to fan operating characteristics. This is especially important in the case of multi-speed motors for proper speed reduction.

In the group of single phase alternating current motors, the common types used with unit heaters are: split phase motor, capacitor motor, and shaded pole motor. Probably the most popular and widely used unit heater motor is the split phase motor. It is standardly used as a constant speed, single voltage motor, and in some instances as a two-speed single voltage motor. The dual voltage, three speed capacitor motor is the standard multi-speed motor of the industry. Single voltage, two speed capacitor motors have been used to a lesser degree. The shaded pole motor is standard in the smallest fractional horsepower ratings.

Looking to the future of these three types of unit heater motors, it may be well to note that many frown upon the ¼ hp. and larger split phase motors, due mainly to the fact that the starting current is considerably higher than with capacitor motors. Thus capacitor motors may soon be used as constant speed motors of ¼ hp. and larger. Should this change be acceptable to all concerned, it would not be surprising to see this popular standard split phase motor entirely supplanted by the capacitor motor. Along with these changes, designs of capacitor motors will undoubtedly improve to the point where one motor may be used as a constant speed, dual voltage motor and as a two-speed, dual voltage motor, and as a multi-speed, dual voltage motor, with the probability that the multi-speed controller would vary the motor speed not by two, three or four speeds but by an infinite number.

The shaded pole motor is generally used in the smallest ratings of fractional horsepower motors, for this type, like the capacitor motor, has no mechanical moving parts other than the rotor, and when well designed and well built, has proved to be long-lived. This motor is used for constant and multi-speed operation. As designs improve, it will not be surprising if the ratings increase.

The popular types of fractional horsepower polyphase unit heater motors are low torque, squirrel cage induction motors with various windings for constant, two, three or four speed.

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The two types of fractional horsepower, direct current motors most frequently used are the shunt wound motor for single and variable speed, and the series wound motor for single and variable speed in the smallest fractional horsepower ratings.

Propeller fan unit heater motors differ mechanically from standard motors. First, they are totally enclosed to protect them from air borne dust, grit and grease, since they are always operating in the air stream. Second, they have a thrust bearing to absorb the end thrust from the propeller fan. This bearing also prevents end bump, rotor oscillation and resulting noise.

Most ratings of fractional horsepower motors are now available with several different designs of resilient mountings, the most common being the concentric rubber mountings at both bearings.

Centrifugal Fan Unit Heater Motors

Small centrifugal fan unit heaters with direct drive, fractional horsepower motors use similar types of motors as do the propeller fan unit heaters. The larger centrifugal fan unit heaters are usually equipped with standard general purpose open frame motors for normal operating conditions. When operating conditions are severe, such as in air laden with dust, grit or grease, these motors are preferably totally enclosed.

Polyphase motors are more generally used on centrifugal fan unit heaters than single phase motors. The common types of polyphase motors are the squirrel cage induction motor with various windings for constant, two, three or four speed, and the slip ring, wound rotor motor for constant and variable speed.

Single phase motors are commonly of the following types: repulsion start, induction run motor for constant speed; repulsion-induction motor for constant speed; capacitor start induction run motor for constant speed; capacitor start and run motor for constant speed, and capacitor motor for constant and variable speed.

Direct current motors are either of shunt or compound types for constant and variable speed operation.

Motors for Special Applications

Special applications of both propeller and centrifugal fan motors may require special constructional features, such as high temperature insulation for use of motors in high air temperatures encountered in drying ovens and dye houses; specially impregnated windings and cadmium trim for excess moisture conditions; special protective winding impregnations for acid, alkaline and similar atmospheres; special motor brackets and frames for explosive conditions, approved by the Underwriters Laboratories as Class 1, Group D motors for explosive vapors such as gasoline; as Class 2, Group G motors for explosive dusts such as grain dusts.

Since it is human nature to expect unit heaters to run with precious little service, every consideration should be given to features such as oil reservoirs and grease cups to hold a generous supply of lubricants, brushless motors, and similar details which minimize the need of frequent attention.

Unit Heaters Pay Their Way in Modernizing

By C. W. DEXTER†

UNDER present conditions, the use of unit heaters in rehabilitating and modernizing heating systems is an important subject. It represents the tremendous market that is by no means limited to industrial plants, but also includes stores, offices, restaurants, garages, schools and even theaters.

Today the unit heater has so thoroughly proved itself that the large majority of new industrial plants are equipped with unit heaters. There is another large group of factory buildings built before the World War, and prior to 1916 when the first propeller fan suspended type unit heater was introduced. These plants were equipped with the older type of heating systems and now that many of these are wearing out, they are being replaced by the more modern unit heater.

Relatively slower than the industrial field to adopt the unit heater, the store, office and school field has now been won over to it because of advantages such as floor space saving and superior heat distribution.

When unit heaters are used to replace less efficient methods it is a clear case of modernizing for profit and not modernizing for the sake of modernizing. From the moment that the new unit heater system begins operation, the saving begins, and it is no rarity for the fuel savings to pay for the new heating plant in from three to six years.

In many cases, it has been discovered that it was worthwhile to replace a present heating system with unit heaters immediately rather than to wait for it to wear out; a relatively inefficient heating system can be a pretty expensive thing.

During the summer of 1935, Templeton & Kenly, Chicago, replaced a pipe coil heating system with 13 unit heaters with automatic control. Three advantages were discovered from the new system during the following year: First, there was a 15% saving in fuel; second, no floor space was lost in cold spots during the winter months; third, the men actually expressed their appreciation over the provision for their comfort, an important effect on morale as well as production efficiency and health, which should not be underestimated.

When the Harris-Seybold-Potter Company, manufacturer of printing presses in Cleveland, built an addition to its plant a year or two ago, the heating system in the whole plant was revised and the original system of radiators on walls and ceilings was replaced by a new system using 56 unit heaters with thermostats set at 65F. These units not only heat the original building area but also a 25.2% added area.

L. D. Cleverly, maintenance superintendent, reported that even though there is 25% greater area to heat, only 350 boiler-hp. are now used in place of the original 450 boiler-hp. Moreover, every part of the plant and office is now uniformly heated and the warm or cold spots eliminated.

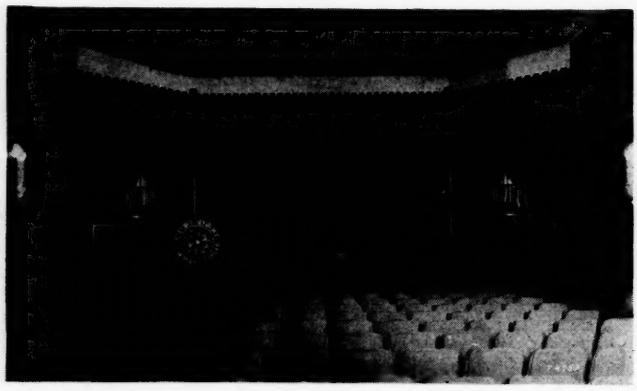
An excellent example of real fuel saving is the case of International Motor Company, maker of Mack trucks. In its Long Island, N. Y., plant 25,000 ft. of pipe coil, 200 radiators and 500 valves were eliminated and replaced by a total of 29 unit heaters with 29 valves and 29 heavy duty traps. The old heating system consumed approximately 300,000 gal. of No. 2 fuel oil per year. The first year after the new unit heater system had been installed, the fuel consumption was 182,000 gal., or a saving of 118,000 gal. of oil—in dollars a saving of about $3200.

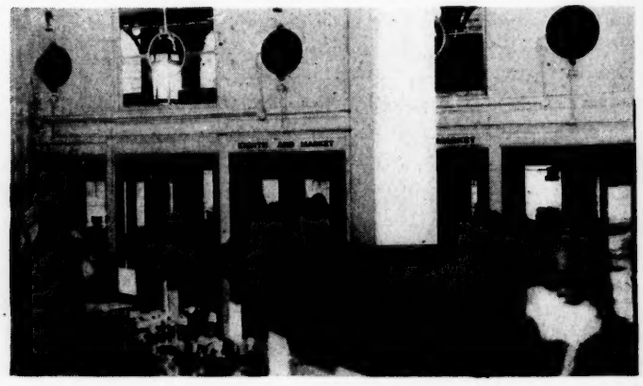
Since the cost of making the change and installing the unit heaters amounted to $6500, the saving indicated an enormous return on the investment aside from the fact that the building is now properly heated.

Illustrations of this kind, both small and large, in the industrial field and the commercial field can be repeated without end. They clearly prove the case for unit heaters and explain why unit heaters will more than pay their own way in the modernizing of any heating plant.

The architect and heating contractor can perform a service for their clients by recommending modernizing with unit heaters and any plant manager or building owner will do well to sit down at once and see what unit heaters can do for him during the coming winter season.

†Ilg Electric Ventilating Co.





(Left) Two unit heaters recessed in the walls of this theater on either side of the stage were blended in nicely with the interior decoration, the units being finished in Seneca red. (Right) Three unit heaters over a vestibule in a Philadelphia department store with only the fans visible. The heaters pull the air from the store, heat it and discharge it into the vestibule under pressure, thus keeping cold air from entering.

Engineering is Important in Unit Application

By H. BERKLEY HEDGES†

THE unit heater today is designed for use in a wide field ranging from the small office to the largest modern industrial plant. There is only one point that is common to all types of applications viz., economic heating of the space which is to be served. Among the variable factors which affect the selection are: floor area, ceiling height, degree of quietness desired, available locations, type of occupancy, evenness of temperature desired within the enclosure, steam pressure to be used in the unit, completely new or addition to present system, spot or general heating, steam cost, power cost, total first cost of installation, possible savings in operating cost of different types for determining advisability of initial expenditure to obtain maximum return on investment, maintenance cost, and many others.

Each application presents its own particular problems and should, therefore, be given individual consideration.

Since the advent of the unit heater, it has become more and more an accepted fact that this method of space heating, regardless of the type of unit employed, is more economical both from first cost and operating cost than older methods.

This is due to the fact that the fans of the units provide a more rapid turnover of the air in the enclosed space by forced circulation than was possible with the former type which depended on natural gravity flow of the air due to temperature difference to provide circulation.

Nature provides that heated air, being of less density than cold air, shall rise. Therefore, when no mechanical means of circulation was employed, this heated air accumulated in the upper part of the heated space and only a small portion was actually effective in producing heat near the floor where required. This resulted in excessive heat losses and high operating cost. Forced circulation as provided in the unit heater mixes the high temperature air with the surrounding lower temperature air and consequently reduces the spread in temperature difference between upper and lower levels, resulting in more economical heating cost.

From the foregoing it is not hard to visualize the possibility of maintaining within a few degrees the same temperature at all levels between floor and ceiling or roof by circulating air in such volumes as to cause a turnover of the air sufficient to provide an almost perfect temperature mixture, and under such conditions, obtain the most satisfactory and economical heating.

Referring again to the law of nature which provides that cold air of greater density falls to the lower levels, it is logical reasoning to say that if the cold air is removed from the floor and the warm air allowed to take its place, that the best general overall results both from comfort and economy will be obtained; and since the B.t.u. output of the unit heater is dependent on the entering air temperature, the greater capacity will be obtained with the lower entrance temperature; therefore, greater B.t.u. for the dollar expended and the power for operation.

B.t.u. capacity is also affected by steam pressure. The higher the steam pressure, which of course carries with it higher steam temperature, the greater the B.t.u. output. Published tables are available giving factors by which the accepted standard basic ratings (B.t.u. capacity under operating conditions of 2 lb. steam being maintained in the heating coil and air entering at 60F) can be multiplied to obtain the capacity under different steam pressures and entering air temperatures.

In order, therefore, to select units of the proper capacity, consideration must be given to whether the entering air is taken from the lower levels, as in the case of the standard floor type unit or suspended units equipped with sheet metal recirculating ducts; or taken from the upper levels, as in the case of the suspended unit without the recirculating air duct.

Care should also be taken not to have too high temperature of air leaving the unit, since the higher the temperature the greater the tendency for the heated air to rise and pocket in the upper levels. The same unit being supplied with the high temperature steam will have a higher B.t.u. output than when supplied with low temperature or low pressure steam. At the same time, the leaving air temperature will be considerably higher while the volume of air handled by the unit will remain the same. Since the volume of air handled and final temperature play a most important part in final results, it is, therefore, inadvisable when high pressure steam is to be used to select the unit or units purely on their B.t.u. output under such steam pressure; but instead, the unit should be selected as if low pressure were to be used but instead of the standard heating coil, there should be substituted a coil having less heating surface so that when it is supplied with high pressure steam the final temperature of the leaving air will not exceed the temperature that would be obtained from the use of low pressure steam. This method provides for large air volumes at low temperatures.

Discharge velocity of the air from the unit plays an important part in the selection of the number and type units to be used. Units of the propeller fan type usually have discharge velocities at maximum speeds ranging from 600 to 900 f.p.m., while units of the blower fan type have discharge velocities at maximum speeds ranging from 1600 to 2500 f.p.m. At lower than maximum speeds both types of units have correspondingly lower outlet velocities with accompanying lower air volumes at higher final temperatures.

Higher discharge velocities naturally mean wider area coverage and fewer units and, at the same time, the higher outlet velocities produce an induced action which causes the surrounding lower temperature air

†Manager of Industrial Sales, John J. Nesbitt, Inc.

to be drawn into the warmer air stream producing a mixture of tempered air which has less tendency to rise and which will travel farther in the projected direction. The induced action produces a still further effect in causing an increased air turnover within the heated space and a thorough mixing of the air, resulting in a more even temperature.

Due to variations in outlet velocities, final temperatures, location of units and direction of air discharge, there will be differences in the distance the discharged air will travel. With normal outlet temperature of approximately 125F and with the air discharged in a horizontal direction, the air from the propeller fan unit with average outlet velocities of 800 f.p.m. will travel approximately 6 ft. for each 100 ft. velocity; while for the blower type centrifugal fan unit with average discharge velocity of 1800 f.p.m., the length of air travel will be approximately 10 ft. for each 100 ft. velocity. These distances of air travel will increase or decrease with corresponding changes in discharge velocities, and decrease with increased outlet temperature and with increased angular downward direction of air discharge.

Wherever air is moved mechanically by a fan, there exists a certain amount of noise. This noise increases with the speed of the fan or volume of air handled; but, at the same time, the capacity of the unit increases. Therefore, from the standpoint of first cost and operating cost, it is more economical to select units on the basis of maximum speeds. There are many applications, however, where this cannot be done and it then becomes necessary to select equipment based on fan speeds that will not be objectionable to the occupants. Units equipped with multispeed motors may be selected for requirements on their lower speed ratings but operated at maximum speed for quick heating up before occupancy, and then reduced in speed for normal operation. In most industrial installations, such as factories, machine shops, assembly plants, etc., unit heaters can be operated at maximum speeds without objection.

Floor mounted units, as the name implies, are located on the floor and should discharge the heated air horizontally at as low a level as possible so as to pass over the heads of the occupants. Eight feet above the floor has been found to be a very satisfactory discharge level. The low velocity propeller fan suspended unit, which generally has its air discharged downward, should be placed at a distance of approximately ten feet above the floor for best results. Blower fan high velocity suspended type units may be placed with their air discharged forty feet above the floor but should be kept lower wherever possible to do so. The higher either type unit is located above the floor, the less the area that can be effectively covered.

The number and location of units to be used naturally depend on the type of units as well as the type of building to be heated and the available locations that will not interfere with operation. No hard and fast rule can be given for direction of distribution but it is advisable to so locate the units to produce good circulation and thorough mixing of the air within the enclosure. Consideration should be given to locating units from the standpoint of steam and return piping and electrical wiring required. Where excessive amounts of infiltration occur, such as garage and shipping doors, it is advisable to concentrate at least a portion of the discharged air from one unit at these points to offset these conditions.

An essential point in satisfactory operating results from unit heaters is the correct arrangement of the steam supply and condensate return piping. The piping arrangements vary somewhat for low pressure closed gravity, low pressure open gravity, low pressure vacuum and high pressure systems.

Standardization in the testing and rating of unit heaters which has been adopted by all manufacturers has done much to help the engineer and user in the selection of equipment. These tests and ratings are made in accordance with the Code for Testing and Rating of Industrial Unit Heaters as determined through the research laboratories of the ASHVE, and which has been adopted by the Industrial Unit Heater Association.

Unit Heaters with Hot Water Systems

By A. G. DIXON†

ALTHOUGH sales of unit heaters for application to hot water heating systems account for barely two to three per cent of total unit heater sales, applications are interesting and deserving of careful, even though passing, observation.

Quickly stated, unit heaters when applied to hot water heating systems possess all the advantages now freely recognized as being owned by unit heaters when applied to steam systems. These include: (1) fuel saving (arising both out of quick responsiveness and out of lowered temperature gradient); (2) improved heat distribution, in consequence of forced circulation; (3) floor and space saving, due to compactness of equipment; (4) flexibility of application—to various kinds of heating and drying problems; (5) moderate cost, both initially and in maintenance and operation.

There are a few fundamental cautions in the use of hot water unit heaters that bear mention.

First and foremost, an ample supply or flow of heating medium must be assured. It should be remembered that a unit heater, for all its modest size, may be equivalent in capacity to several hundred feet of radiation and that a commensurate flow of hot water must be assured. Standard piping sizing as recommended by the ASHVE, by HP & ACCNA, or similar authority should be observed. Elimination of air is important but offers no problem of complexity.

Forced circulation is desirable for the element of positiveness which accompanies it and also because, with forced flow, a given boiler temperature nets a higher average water temperature in the unit heater,

†Sales Manager, Modine Mfg. Co.

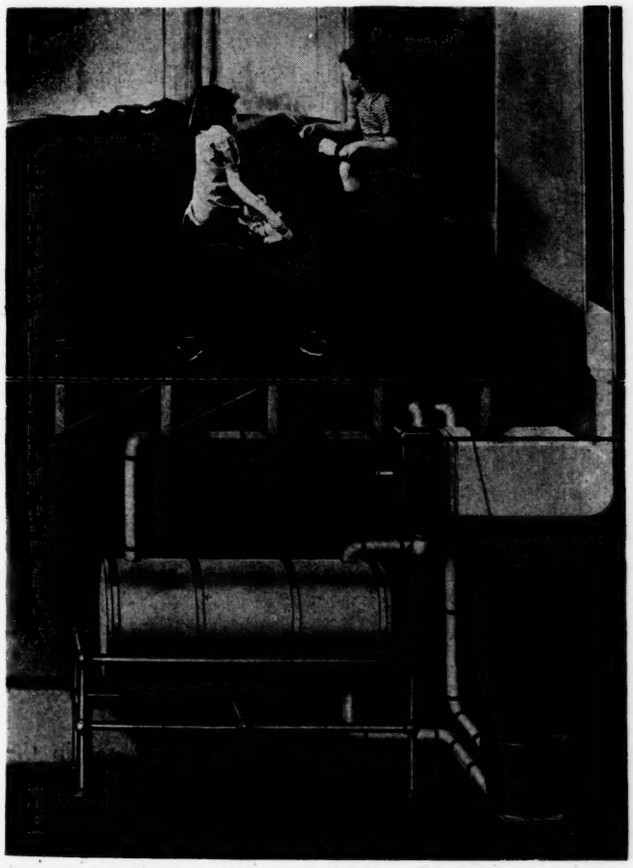
hence steps up the unit's capacity. However, if reasonable and commonsense care in system design is used, a gravity flow application of unit heaters is quite reliable.

A final word of caution is to avoid too low an outlet temperature from a hot water unit heater. Air leaving a unit heater at 100F, or less, will reach the working areas at 80 to 85 and may be uncomfortably drafty.

Air conditioning's growth in popularity has influenced use of hot water unit heaters, just as it has had a bearing on every other department of old line heating. Where unit coolers which use cold water as a medium are installed in a store or office area, it is not unusual to use the same units for water heating by supplying hot water to them. If the building is provided with a steam system, a heat exchanger may be used to heat water. Fortunately the usual job, if sufficiently cooled in the manner just described, will be easily taken care of in heating requirement with the same water heat transfer equipment.

Hot water unit heaters are quite popular for residential heating. In a recreation room or attached garage, the quick responsiveness and space adaptability of the unit heater are obviously welcome attributes.

A residential application receiving marked attention of late is that of connecting a hot water unit heater to a tank heater system. This combination is popular for supplementary heating including (a) spring and fall heating when main (especially coal fired) heating plant operation is not justified; (b) as a booster to regular heating system in severe weather; (c) to heat an added room where boiler or furnace are too small to absorb extra load; and (d) to dry clothes or heat a basement recreation room.



Supplementary house-heating with hot water unit heaters connected to a tank heater. Return air uses house as a plenum.

Year-round performance in this drugstore where these ceiling units—primarily unit coolers—circulate hot water during the winter.

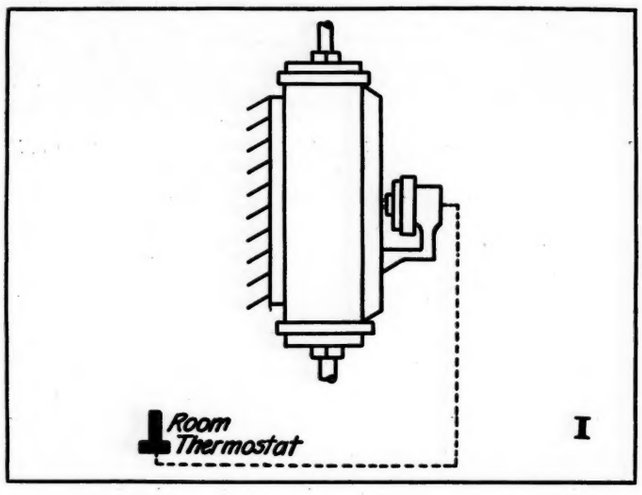
Hot water unit heaters are ideal for the combined purpose of carrying excess heat from diesel engines and of heating a building with such excess or waste heat. In such an application it is essential that the units perform their function of cooling the diesel engine jacket water at all times, whether it is winter or summer. Hence, while unit heaters should as usual be located with an eye to best heat distribution in the room, they should also be spotted so as to provide easy exit of an outlet duct from the unit. A Y-duct from the unit, its short straight branch opening to the building, should have a second branch curved off horizontally or vertically respectively to wall or roof, then through same and to out-of-doors; a quadrant damper causes heated air to flow into building in winter, out of doors in summer. Exhaust effect in summer is helpful. In this type of system especially, hot water supply and return piping should be well insulated. Relocation of unit heater deflectors on face of short straight duct is advisable. Suitable synchronization of diesel engine and unit heater automatic operation is essential to protection of engine.

The cost of a heating plant using hot water unit heaters vs. cost of a heating plant with steam unit heaters is in inverse proportion to the mean temperature potentials employed in the two systems. This relationship will be a closely approximate one for the unit heaters, for piping, and for boiler. It follows that raising boiler water temperature to about that of steam wipes out this difference.

Especially where waste heat is available and many times else, hot water unit heaters are worthy of consideration in industrial heating. For commercial use, they are desirable as combined unit coolers-heaters. In residential work, hot water units may be either connected into the main heating plant or attached to a tank heater supplementary system. The field of application, while not deep, is thus obviously broad and is exceedingly interesting.

Automatic Controls Insure

EARLY installations of unit heaters were hand controlled by operating a heat supply valve or by starting or stopping the fan. Even now in industry this method of control is still practiced. As the unit heater has moved into wider fields, however, the necessity for automatic control has become steadily more appreciated and such control is generally provided. Yet, unless specifically requested to supply controls many contractors and engineers may omit this important item and the installation is immediately handicapped in performance.



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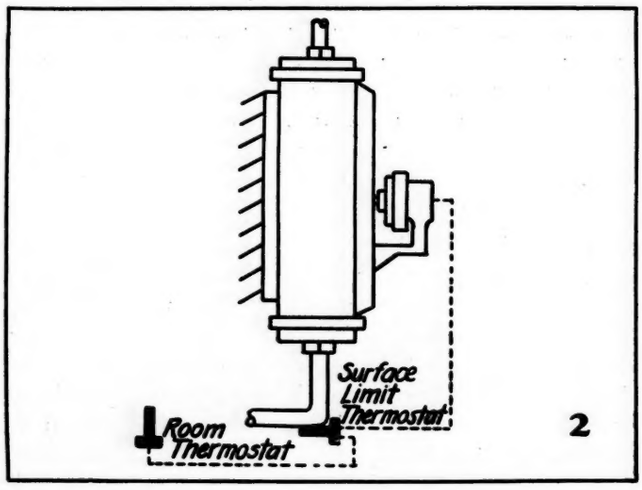

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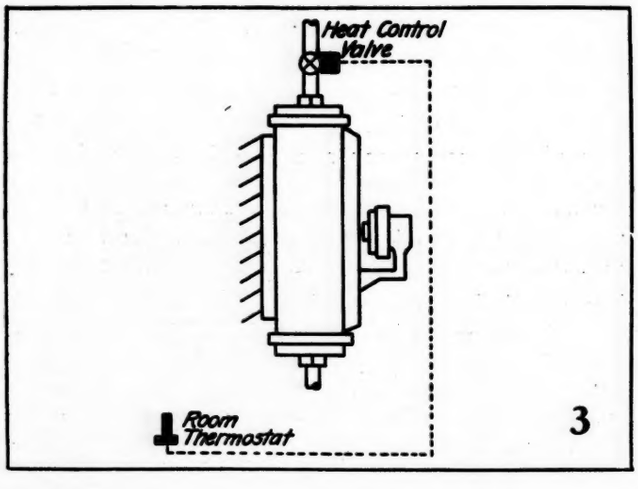

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The problem of applying controls to a unit heater installation consists of selecting suitable control equipment from that on the market and then so arranging it that it will operate the heaters in a way to secure the results desired. The problem is usually simple once the type of heater to be used and the exact purpose of the installation are definitely decided upon.

Equipment used consists of room thermostats, relays, valves and dampers, pressure or temperature actuated switches, limiting thermostats and switches, humidistats, and, generally, all the items of control equipment. Control of unit heaters has made necessary but little specialized equipment, for the same elements used for control of other heaters can be applied to them. As in every other case of selecting and applying control equipment to a particular installation it is essential that the details be fully understood and that all the operating requirements be taken into account. It is also useful to keep in mind that once the function is clear it is usually possible to find suitable equipment actuated by electrical energy, by compressed air, or by expansion and contraction of a liquid or gas. Frequently, the judicious use of all these sources of energy is indicated in complicated and unusual cases, but in the most common cases a simple selection of one energy source is indicated.

While the control problem can never be standardized because of the great variety of special cases which arise still there are certain situations of so common occurrence that almost standardized methods are used. Some of these are outlined here.

First, consider only unit heaters where there is full recirculation of air and no connection to outside air, no mixing dampers. Here there are two common situations, viz: (a) the heater is operated intermittently and is required to heat only, and (b) the fan operates continuously because air circulation as well as heating is required.

In the first instance the simplest control consists of a thermostat for starting and stopping the fan motor, as illustrated in Fig. 1. This simple method is commonly supplemented by a limit switch control so arranged that the fan motor cannot operate unless there is heat in the unit. The object is to prevent cold drafts from the fan. The limit device may operate on temperature or on pressure and may be inserted into the supply or return connection, put into the discharge air stream, or clamped or strapped on the surface of the supply or return piping. Fig. 2 illustrates such a method, while Fig. 4 has the limit thermostat in the air stream just as it leaves the heating surface. If set at say 160F the fan cannot operate unless the air at the discharge side (Fig. 4) is 160F or over.

When the fan operates continuously the simplest control, as shown in Fig. 3, is a thermostat actuating a valve in the supply piping. This can be so arranged

Satisfactory Performance

that the valve will be either of the full-open or full-closed type or the thermostat can operate to position the valve stem automatically between full-open or full-closed. In Fig. 4 this same simple control is shown with a modulating valve at the inlet and a low limit control in the delivered air stream. The same plan can be used with a high limit thermostat to stop the fan if serious overheating is encountered.

Another class of almost standardized methods is that where there is a combination of control at the supply valve and at the fan.

One example of this is found in a method which uses a motorized valve at the steam supply under the control of a room thermostat and which is connected mechanically to a second thermostat which actuates the fan motor through a low limit switch. When the room thermostat calls for heat the supply valve opens and puts the fan motor in position to operate as soon as the return line is hot. With this control the heating surface is cold when the fan is not operating and the motor is not adjacent to a hot surface without being cooled by an air stream.

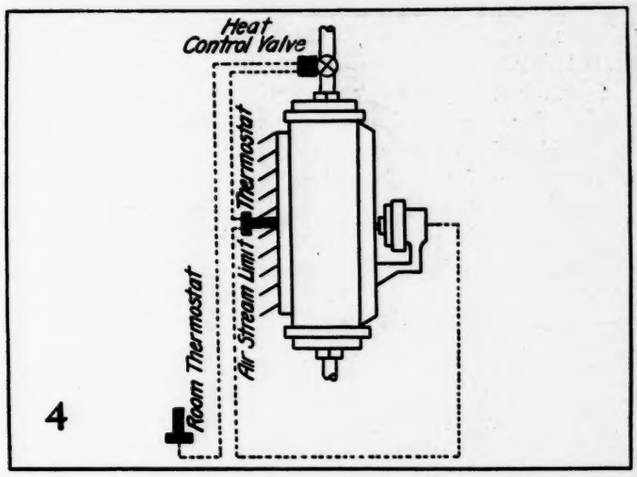
Another is a hookup for preventing high ceiling temperatures. As shown in Fig. 5 the general method of Fig. 4 is modified by locating a second thermostat in the return air stream near the ceiling. It starts the fan whenever the air temperature near the ceiling rises above a predetermined point.

A frequently encountered situation is that where several heaters are controlled from one room thermostat but when it is not necessary to turn on all heaters at once, as would be true in mild weather, for example. Fig. 6 shows such a control method which makes use of a pressure type limit control at each heater and with each limit control set to function at a different pressure. Varying the steam pressure in the line, either automatically or normally, makes it possible to operate all, none, or as many of the heaters as desired.

Where unit heaters are connected to outside air or where they have air regulating dampers incorporated in them the control problem approaches that found in central heating and ventilating systems and is usually quite different from those described here. Control methods used in such installations are described in HEATING & VENTILATING for March, 1936, pages 51-54.

In applying controls to unit heaters there are several "don'ts" which should be watched. First, improper location of room thermostats is a common fault. Such a thermostat must not be located where it is in the direct path of the heated air discharged by the unit or units whose operation it is controlling. A good location can usually be found in the path of the air returning to be reheated. Second, if electrical devices are used be sure the electric characteristics as regards current and voltage are suitable and that the rated load of the control device is not exceeded. Third, if a single room thermostat is to control the operation of several units use care in selecting the group to be controlled so that as accurate regulation of temperature as necessary to meet the requirements may be secured.

Acknowledgment of assistance in preparing this statement regarding present methods of control used with unit heaters is made to practically all the manufacturers of control equipment and especially to Johnson Service Co., Detroit Lubricator, Minneapolis-Honeywell, Barber-Colman, Julien P. Friez & Sons, and Sarco, Inc.



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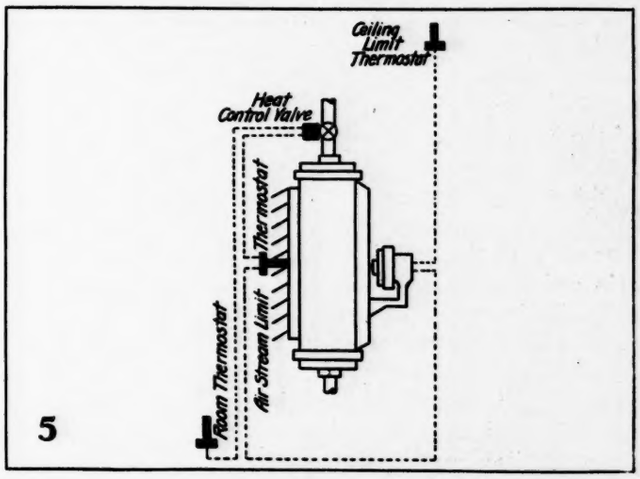

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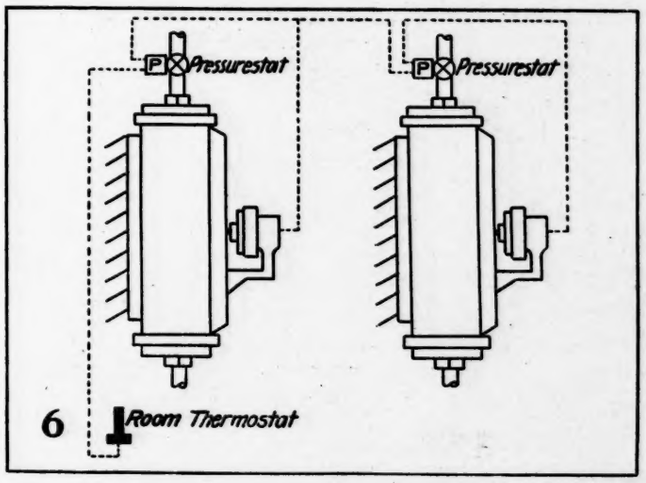

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Using the Unit Heater for Preventing Building Condensation

By J. F. TOBIN†

IN many buildings it is necessary to consider the humidity conditions existing inside during the heating season, to prevent condensation on the building structure and on the material stored inside, which would deteriorate the stored material and increase the maintenance expense on the structure itself.

In order to properly consider this problem, it should be divided into two general types: First, a building where no moisture is given off by the product or processes carried on inside the building, and second, a building where there is considerable evaporation of moisture from the process carried on in the building.

No Moisture from Process

The first type is perhaps best illustrated in a warehouse erected for the storage of steel in the form of structurals, plates, bundles or rolls, piled on the floor with narrow aisles between piles, tending to restrict natural circulation. There would be no need for heating such a warehouse were it not for the condensation problem as there are usually few men working in the storage area.

As the outside temperature drops at the beginning of the heating season the steel is hotter than the building air. During a warm spell following a stretch of cold weather or at the end of the heating season, the outside air that filters into the building is considerably warmer than the stored steel. Due to the melting snow, rain and general evaporation, the absolute humidity or dewpoint increases appreciably and is apt to be higher than the temperature of the steel stored in the warehouse. Since the natural circulation of this humid air through and around the stored steel is very much restricted, condensation readily occurs on the steel with resultant discoloration and rust.

If the warehouse is heated by unit heaters, the contents remain at nearly constant temperature during the heating season. This temperature need only be high enough to safely exceed the maximum outside dewpoint in order to prevent troublesome condensation. With proper design, the air circulation is sufficient to minimize stratification of air and prevent cold spots which could localize a high humidity condition.

The selection of unit heaters for such a building is usually on the basis of heating the warehouse without contents to a temperature of 40 to 50F at the usual outside design temperature. Heaters should be of the recirculating type without fresh air connections. The blower type unit heaters are generally preferred for buildings with high ceilings and the disc fan type unit heaters are generally used in buildings with lower ceilings. Where the steel is piled very high or the aisles are appreciably restricted or few in number, floor intake unit heaters are recommended with extended discharge cowls or recirculating intake ducts. This arrangement will distribute hot air horizontally just over the piles and induce a return air flow along the floor.

The dewpoint inside the building closely approximates the outside dewpoint, due to building infiltration and absence of interior evaporation. The initial condensation condition on the cold steel will not exceed that to which the steel has already been subjected in transportation. Upon being placed inside, the steel will gradually increase in temperature to the design temperature of the building.

Moisture from Process

The second type is characteristic of such buildings as dairies, creameries, killing floors of packing plants, steam cooking processes, etc., and is complicated by the necessity of continuously adding sufficient dry outside air to the building at room temperature in order to control the relative humidity to a value that will not cause condensation on the building structure. The allowable relative humidity depends upon the building construction, i.e., a well insulated building structure with storm sash will carry a higher humidity without surface condensation than will another building of similar size without insulation and single glass windows.

The amount of moisture that will be evaporated in a given time has a direct bearing on the amount of outside air that is required, but unfortunately, it is most difficult to estimate because it is a function of the relative humidity, air velocity, surface temperature, etc. It must be kept in mind, however, that all these factors work in the same direction, i.e., a rather poorly constructed building necessitates a lower humidity and a greater air circulation from the unit heaters, on account of increased heat losses which tend to increase evaporation and make necessary a greater quantity of outdoor air.

A general rule that has been used for a number of years is to provide unit heaters having sufficient capacity to supply outside air at the rate of from six to twelve air changes per hour and to provide sufficient heat to maintain building temperature.

Occasionally, the building construction is sufficiently open to permit adequate air relief, but exhaust fans are generally necessary and should be selected for approximately 75% of the fresh air capacity of the heaters. They should be placed as close as possible to the source of the major portion of the moisture being evaporated into the atmosphere.

†American Blower Corporation.

Unit heaters for use on this service can be divided into two types: first, those which operate intermittently with constant air temperature; second, unit heaters designed for constant air flow at variable discharge temperatures.

Successful installations of the intermittent operating type unit heaters are common on this type of application and are particularly successful on installations using more than one heater. A sufficient number of heaters are connected to outdoors for ventilation duty primarily, either with or without a manually operated damper to permit partial recirculation. If necessary, in order to maintain room temperature, additional heaters are installed on recirculating service only with room thermostats.

Assuming that the job is correctly estimated and the humidity condition exists as expected, all the heaters will run in the very coldest weather. As the outside temperature rises the room will tend to overheat and the room thermostats will progressively shut off the recirculating units. As the temperature outside further continues to increase, the ventilating units will begin to overheat the building at which time they can be shut off manually since the need for ventilation to prevent condensation will diminish in milder weather.

It is not practicable to throttle the steam supply to the coils of the fresh air units which are equipped with standard single heating coils unless the control is arranged so that throttling is effected only at air entry temperatures above freezing in order to avoid bursting the coil of the heater by freezing of condensate when the coil is partially filled with steam. It is readily apparent that there is no control of the individual ventilating unit handling constant quantity of outside air below freezing temperature, and the control of the entire installation depends upon progressively shutting off heaters beginning with the recirculating unit heaters and finishing up with the last of the fresh air units. For this reason this method in certain problems is hardly as satisfactory as the following for the more severe jobs.

Use of Double Coil Units

The constant air flow variable delivery temperature units are quite frequently furnished with double coils so that the delivery temperature from the unit when handling cold air will be approximately the same as when used on recirculating service. This maintains its capacity to heat the building, the extra coil being sufficient to heat the outdoor air from outside design temperature up to room temperature. It is thus possible to use fewer of this type of heater resulting in a simpler installation. These heaters should be installed with manual fresh air and recirculating dampers which can be adjusted to admit only sufficient air to prevent condensation. The air delivery temperature control dampers in the heater are automatically controlled by a thermostat in the room to maintain required temperature in the working area. It is common practice to have this room thermostat work through a pilot thermostat in the discharge cowl in order to provide a low limit on the discharge air temperature of approximately 60 to 70F. This prevents a draft from too cold air delivery.

A single unit installation will handle a room of considerable size, controlling temperature and humidity each independent of the other, with the minimum amount of steam when properly adjusted.

In general blower type units are preferred for outside air connection, as the fans have greater static pressure producing ability and are therefore less affected by the relative tightness of the building and the wind pressure on the building. Although where adequate exhaust is provided propeller type unit heaters on outside air service are quite satisfactory.

All steam unit heaters with outside air connections should have thermostatic relays clamped to the condensate or drip line from the coil, to shut off the unit heater fan motor in case the line gets cold, indicating failure of the steam supply. This is desirable in order to protect the coil from freezing and also to prevent lowering the room temperature under abnormal conditions. Installations have been made of safety controls that operate in a similar manner from steam pressure on the coil or from vacuum on the return line as well as from a combination of these two methods in a differential pressure circuit.

The fresh air and recirculated air dampers on ventilating type unit heaters are generally manually controlled with the operator being instructed to shut off the fresh air damper and open the recirculating damper when the building is not in regular production service and requiring ventilation to reduce humidity. Many installations have been made in which the fresh air and return air dampers are automatically controlled through a relay from the fan motor circuit, so that when the motor is started the fresh air damper opens and the recirculated damper closes to a manually adjustable degree and remains in that position during the period the heater fan motor is operating. Upon shutting off of the heater fan motor the fresh air damper automatically closes and the recirculated damper automatically opens, thus eliminating the possibility of human failure to operate these devices and to save the consequent loss of steam during the non-working period. Operation of these dampers is also possible from a room humidistat control to maintain a definite humidity, but this refinement is seldom necessary on the average installation.

In the limited space available it is possible to do little more than present a rough outline of application data and touch a few of the more important aspects of this problem. The constant improvement on unit heater design, construction and application has steadily widened their field of application in preventing condensation as well as maintaining proper temperatures in factories, warehouses, and similar structures.

The Other Side of Unit Heating

By DARRAGH L. HIGGINS†

UNIT heater articles usually describe the success of a particularly difficult job of heating. The writer maintains that there is the other side of unit heating —and the customer is always right. It would be possible to write a glowing description of the installation, success and test of numerous installations, but let's consider this other side for a moment instead.

Every unit heater sales manager knows about, and can discuss violently, undersized steam pipes, high pressure traps on low pressure jobs, lack of air vents, reversed check valves and failing steam supply. He finds out about these things through complaints, and someone has to investigate. He also knows of cases of improper selection of units; the incorrect use of same, and he is thoroughly familiar with the fact that three-phase unit heater motors are frequently hooked up in such a manner that the motors will run in reverse, and that they are left that way until he, or his assistants in the field, investigate.

In addition to these troublesome errors, the writer's activities dealing in the sale and engineering of unit heaters over a ten-year period have been punctuated by some startling installations that made it difficult to be calm, helpful, and to remember that the customer must always be right.

There was the case of a unit heater equipped with a bypass damper in a foundry, and the complaint was that the unit continued to increase the heat in this building regardless of what the thermometer showed. Investigation showed that the thermostatic control of this damper motor had never been connected with any electricity.

Then there was the "Rube Goldberg" hookup, whereby the customer had proudly connected a thermostat to a relay that operated a furnace damper motor, that operated a toggle switch that shut off the motor of the unit heater. Customer said that it got out of order and would not hold the temperature to a predetermined level. The elimination of everything except the thermostat and unit heater worked wonders.

There was the case of the chap who religiously read the advertisements and wrote to inquire if a unit heater would heat his garage. The answer being in the affirmative, he sent in an order and a check for one unit. Several days thereafter, his letter stated, "Have run this heater for four days, and have not heated the garage yet." It was found that it was a one-car garage behind the house, and the nearest source of heat of any kind was a hot air furnace in his home. A refund took care of the situation.

Actually a person installing—not a steamfitter as it should have been—called up and inquired how to get the unit out of the crate in which it had been shipped. He was informed to take a hammer, gently but firmly in his right hand, remove several nails, and take the unit out, for which thanks were given. Later, on the same job, this person called again and stated that he thought the unit was excellent in appearance and added to the general beauty of the room to be heated, but although the steam had been on the unit for several hours, he could not see anything particular that had happened. Rushing to the scene of the job, it was found that the motor had not been connected, and this person stated he had wondered why there was a motor on the unit.

There was the case of a misguided mechanic who hooked up a unit heater to a one-pipe system and found it necessary to run a loop in the piping under a beam. No amount of explanation to this gentleman could make him understand that this loop or depression formed a perfect trap, and would not allow the passage of steam in one direction, while the condensation was being returned in the other. While this writer does not particularly care for the use of a one-pipe steam system in connection with unit heaters, it did so happen that the piping in this case was of sufficient size so that it was possible to run a loop both over and under the beam in question, and a fair amount of success was had as the result.

The situation was bad enough as it was, but before the job was finally connected, this same mechanic attempted to be his own electrician. The motor was supplied with two binding posts inside a junction box for connection to the electric current. This person thought that the motor should be supplied with two wires leading out of the motor, and proceeded to furnish same by taking off the end-case of the motor, grabbing the first wire in sight, cutting it, thereby giving him two wires to pull through the binding post hole, he having removed the binding post. The strange part of it was, the motor stood the shock and did not go up in flames. Moral—get a qualified electrician.

A letter was received one day which attempted to

A alarm clock lowers fish food into goldfish bowl,
C cat springs for catnip ball,
D thus, pulling lever shutting off motor of unit heater
B fish pulls string releasing cat—

...then there was the Rube Goldberg hookup

†B. F. Sturtevant Co.

...so he called up to find out how to get the unit out of the crate

prove that the tubes in a unit heater were so small that the steam could not get through on account of high resistances. There were two pages of calculations, all erroneous. After correspondence failed, a 300-mile sleeper jump was the result, and the contractor rather proudly pointed out that there was nothing but cold air coming from the unit heater. Disconnecting the return side of the unit heater did not produce any water or steam. Disconnection of the steam side of the same unit gave the same results. Instructions to turn on the steam at its source failed to produce anything, but tracing the steam and return line back towards the boiler did show that 10 ft. of pipe originally intended to cross a corridor had never been put in place.

It is an old trick, but a poor one, when a customer decides that he needs more air through the unit heater and proceeds to improve upon the fan design by twisting the blades to a sharper pitch. True, he gets more air, but it is also true that the motor has more to do, and eventually fails. Also the fan wheel is almost always out of balance by such treatment, nevertheless, this has been the cause of more than one gray hair.

In one day, two letters were received: one complaining that the tubes in the unit heater were too small; the other complaining that the tubes were too large. The only thing that was correct in both letters was that there was very little steam in either unit. Check-up showed the boilers were too small in both cases, and could not supply sufficient amount of steam.

Believe it or not, there was the case of the parsimonious garage owner who had been in the habit of buying a ton of coal per winter, and using it in a small round-house stove, around which his mechanics were able to warm their hands at various times. Someone sold him the idea of putting in a complete installation of unit heaters, boiler and mechanical stoker. The complaint was that the units failed to heat his garage. After the investigator had built a fire in his boiler, he felt that everything was straightened out to suit everyone, only to receive another complaint the next day. It then developed that the owner had burned up his one ton of coal for the year's heating, and had no idea of purchasing any more until the following year. The argument from then on was one sided, because the owner insisted that there were the words "unit heaters" on the machines and that meant to him that regardless of whether he burnt coal or not, his garage was supposed to be warm. The hard part to believe, but nevertheless true, is that although he paid $3000 for a perfectly good installation, he tore it all out and disposed of most of it at junk prices.

On at least three occasions it has been necessary to handle the chap who stated that his building was cold, but nevertheless had the controlling thermostats set below the desired temperature. When the customer was not looking, we confess to the act of pushing the thermometers on the thermostats down six degrees on the scale. By so doing, they were actually getting more heat than they felt they were paying for. These people have been very happy ever since.

All of the cases just quoted actually happened and were handled as indicated. But what does one do when the following letter with its voluminous information is received. "Have installed two of your unit heaters. They don't heat. Why?"

Letters of this type usually come from a point 2,000 miles away from the nearest office. It is probably just as well for the sanity of the man in charge that such cases have to be handled by mail.

We unit heater people may seem queer to some, and it has been said that we act rather crazy after the serious business of a Convention is over—but why not? It is necessary to get our mind off our business once in a while. But after the Convention we go back to our offices and continue to improve our unit heaters.

In conclusion, it is respectfully suggested that when a unit heater is correctly installed the customer will enjoy the art of unit heating.

...there were pages of calculations, all erroneous

Association Adopts Standards for Propeller Type Heaters

FOLLOWING a long period spent in preparation, the Industrial Unit Heater Association adopted and put into effect on June 1, 1938, its "Standards for Propeller Type Unit Heaters." It is believed that the Standards as adopted will eliminate useless sizes of propeller type unit heaters.

Adoption of this new standard follows the preparation and adoption of the standard test code for rating unit heaters which was one of the major steps in the standardization program of the Association. This standard test code has now been in use for a long period and at the time of its adoption represented the first attempt at standardization in this field. It is reported also that as another step in its standardization program a committee of the association is at work on the preparation of standard steam piping diagrams for the propeller type unit heaters.

Members and Officers

The Industrial Unit Heater Association is composed of the following 20 manufacturing companies which include many of the best known makers of unit heaters: Airtherm Manufacturing Co., American Blower Corp., Autovent Fan & Blower Co., Buffalo Forge Co., Carrier Corp., Clarage Fan Co., Fedders Manufacturing Co., Inc., Grinnell Co., Inc., Ilg Electric Ventilating Co., Johnson Fan & Blower Corp., McQuay, Inc., Modine Manufacturing Co., The Herman Nelson Corp., John J. Nesbitt, Inc., The New York Blower Co., Niagara Blower Co., B. F. Sturtevant Co., The Trane Co., L. J. Wing Co., and Young Radiator Co.

The present officers of the association are: President, J. F. G. Miller, B. F. Sturtevant Co.; vice-president, J. M. Frank, Ilg Electric Ventilating Co.; and L. O. Monroe, secretary-treasurer.

The complete text of the standards for propeller type unit heaters follows:

1. Sizes of Units

"No Manufacturer to make or list more than twenty-five (25) sizes of the propeller type unit heaters of the horizontal shaft design for comfort heating between the limits of 15,000 to 350,000 B.t.u."

"A Unit size is defined as a combination of a *certain* heating element with a *certain* propeller type fan and a *certain* speed motor, said combination to be rated at its maximum 60 cycle operating speed. Rating to be at 2 lb. steam pressure and 60° entering air, in accordance with the code for testing and rating unit heaters. The maximum final temperature of the air leaving the unit at the above basic rating is not to exceed 135°."

"When this same combination of heating element and fan is equipped with a lower speed motor, it is not considered a new size. When the same combination of heating element and fan is supplied with a decorative, or so called DeLuxe, casing or a peculiarly shaped casing in such a manner so as not to affect the basic rating, it is not considered a new size."

"When the heating elements, or fan, or both are changed so as to alter the basic rating then it is considered a new size unit."

2. Warranted Operating Pressure and Temperature

"Price Sheets and/or rating tables of each Manufacturer to state prominently the guaranteed steam pressure and temperature."

3. Outlet Velocity

"Rating tables of each Manufacturer shall state outlet velocity measured at final temperature of air in accordance with the following formula:

$$V = \frac{CFM}{A}$$

where

V = Velocity in feet per minute
CFM = Cubic feet of air measured at final temperature
A = Net area of outlet opening in square feet less 7½% to compensate for obstruction due to outlet louvers.

4. Ratings in Accordance with Standard Test Code

"Manufacturers to consult the Standard Test Code and to include in their ratings such values as are specifically called for in the Code."

For convenience, these requirements are covered as follows:

(a) The Basic Rating (29.92" barometric pressure)

1. Steam pressure, 2 lb.
2. Entering air, 60° F.
3. R.P.M. of fan at full load speed.
4. Heat output (B.t.u. per hr.)
5. C.F.M. (70° F.) air delivered.
6. Brake horsepower for conditions established by items 1 to 5 inclusive.
7. Final temperature, degrees Fahrenheit.

Note: It is intended that the data for the basic rating shall always be published by the manufacturer. If a manufacturer wishes to publish additional ratings for other conditions the Code provides the following:

"The rating shall state the *steam pressure* (29.92" barometric pressure) and the *entering air temperature* at which the *B.t.u.* and *final temperature* are taken. It shall also state the *temperature* at which the C.F.M. value is taken (i.e. 70° F. or final temperature or entering temperature)."

It is optional whether motor horsepower, condensate in lb. per hour, and equivalent direct radiation (E.D.R.) shall be included.

Electric Unit Heaters

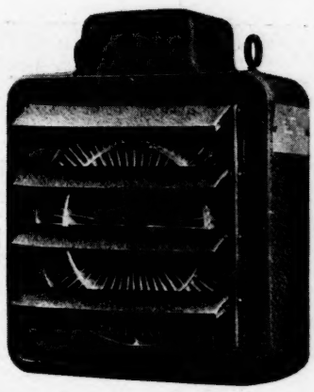
By L. R. MAST†

IN comparing the number of electric unit heaters sold in a year's time with the great volume of steam unit heater business, the former appears rather insignificant. There is, however, a definite market for the electric type and this is growing broader each season. Except for a few localities, the cost of power and severe climate do not favor electric heat but where consideration must be given to problems of flexibility in operation; difficulty in running long steam lines and returns; short periods of full heat demand, and like factors, the electric unit heater fills a real need.

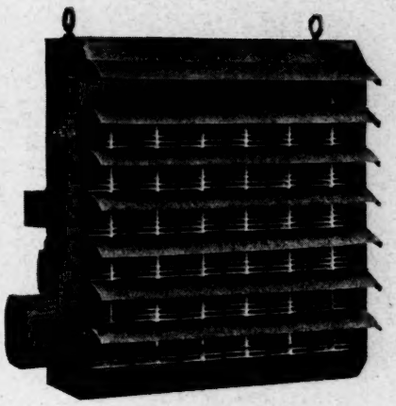
In the past, a great many local power companies have either been disinterested or have actually discouraged the sale of electric unit heaters. On the face of it, this seems to be rather paradoxical as it would appear that electric heat having a 100% heat conversion factor would be greatly encouraged. After examining the power company's standpoint, however, a number of undesirable facts are uncovered. In many applications, the electric unit heater load would come during the normal peak demand, which is exactly what the power company doesn't want. Also, in some of our more industrially crowded centers, the distribution systems are already taxed to the limit. These and other circumstances have helped to discourage the development of any large volume of business. It will be realized, however, that they are temporary difficulties and, with the increased demand for electric unit heaters, are certain to be overcome.

Probably the greatest advantage of the use of electric unit heaters is the extreme flexibility they provide. They can be mounted almost any place with a single cable being the entire source of power. Heat is available instantly at any time during the day or night and in any desired quantity. One manufacturer of this type of equipment produces standard unit heaters almost exactly the same in appearance as the steam units, and in capacities from 3415 B.t.u. per hr. to 614,700 B.t.u. (1 kw. to 180 kw.). The illustrations show standard designs.

As an example of the flexibility of electric unit heaters a large wholesale grocery supply house shipping carload lots of canned goods has found the use of a 204,900 B.t.u. heater (60 kw.) very profitable. In shipping these goods during the cold season the heater is rolled into the empty freight car on a small truck. Power to the 60-kw. heater is supplied by means of a single rubber covered cable. There are no problems of delivering steam and getting returns back properly. After the goods are stored the car is again warmed before sealing the doors. Even in extreme weather this method has been found to keep the canned goods from freezing in making rather long hauls, such as Chicago to St. Louis, or St. Paul.



An electric unit heater with a circular heating element



Another type of modern unit heater

In many localities where industrial power can be obtained for a 1½c or 1c per kw-hr., plant heating engineers have found it possible to cut the cost of a season's heating bill materially by using electric unit heaters during the early spring and fall months and shutting down their steam boilers. One manufacturer in the middle west found that by shutting down two 175-hp. boilers when the outside temperature is high enough heat is no longer needed in the machine shop, and that by heating their office building electrically in the early spring and fall the saving in coal consumption pays for the electric unit heaters and cost of installation in a single season.

An application in the fruit industry will also illustrate a good use of electric unit heaters. Bananas, pears, and other similar perishable fruits are kept in cold storage warehouses until ready for market. Each warehouse has one or more ripening rooms large enough to hold about a carload of fruit. Bananas are, of course, stored in partly green condition and must be ripened or yellowed when shipped to market. This is accomplished by placing them in ripening rooms and raising the temperature to about 74F for a short period. The demand for this may come at any time, and due to this and the ease of accurate temperature control the electric unit heater is being used a great deal. Also due to the ease with which it can be moved about, a single electric unit may be used for several ripening rooms. The cost of equipment is thereby kept at a minimum.

Regardless of the power rate schedule the use of electric unit heaters is cheaper for many applications than any other method when all the facts are considered. These should include first cost of equipment and installation, cost of power or fuel, cost of operation, including attendants if required, interest and depreciation. Some of these applications are: mausoleums; sub-stations; isolated buildings, broadcast booths, summer cottages; press boxes, ticket offices, factory and foremen's offices, auditoriums, switch rooms, pattern shops, etc.

†Engineering Dept., Electric Air Heater Company.

In sections of this country where the heating season is both short and mild, electric unit heaters are being used more and more each season as the entire heating system. In these applications the light heating demand fluctuates so greatly that the high installation and operating costs of a central heating plant are not justified.

As far as construction is concerned, there have been many improvements in electric unit heaters during the past few years. The source of heat is, of course, resistance to flow of electric current in nichrome wire. There are a number of methods in utilizing and dissipating this energy. The three most important being (1) the open wire, (2) the tubular or flat strip element, and (3) the finned surface cast on, electrically brazed or welded. Each particular design has its favorable points.

In the accompanying photos are pictured unit heaters of the cast grid construction and the type of element used. The heating element itself is constructed with aluminum fins cast on a tubular heating rod. This rod consists of a helical length of nichrome wire centered in a steel sheath and insulated from it by means of powdered magnesium oxide, this material being a highly efficient electrical insulator and at the same time a fair heat conductor. The aluminum finned convection surface is poured around and shrunk on the rod making an integral unit. The advantages of the particular type of construction are the greatly increased convection surface permitting high capacities in small overall dimensions, the sealing of all wire from oxidization, low element surface temperatures, and very rugged construction. The principal disadvantage is the attendant high cost of manufacture.

One of the most important facts to be considered in the design of an electric unit heater is that it produces a constant B.t.u. output regardless of the temperature or volume of air passing through its fins. For example, a 15-kw. unit is dissipating 51,225 B.t.u. per hr. whether the air volume going through the fins is 400 c.f.m. or 900 c.f.m. In the former case, however, the surface temperature of the elements would be very high and in the latter just fairly warm. Since the surface temperature on the elements varies with the air volume, in a unit heater where considerable electrical capacity is crowded in a small overall dimension, it is apparent that a minimum amount of air must pass over the fins to prevent excessive surface temperatures being built up. To guard against damage from stoppage of air flow every heater is equipped with a safety switch (usually some sort of a thermal overload or thermostatic bi-metal) which automatically operates to disconnect the power under such conditions.

The modern electrical heater represents a very rugged construction highly efficient in operation and pleasing in appearance. With the friendlier attitude of power companies and the downward trend of rate schedules, the use of electric unit heaters is certain to assume an increasingly important place in the heating field.

The Gas-Fired Unit Heater

By A. M. MARBLE†

FROM heating the tiny shop up to the heating of huge buildings such as Chicago's Navy Pier—a building 2300 ft. long by 67 ft. wide—the gas-fired unit heater finds wide application. For that reason, it has become a subject of great interest.

Mechanical Makeup

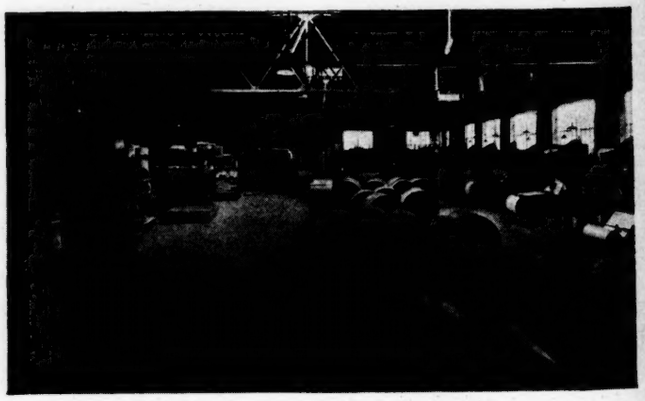
For the benefit of the unitiated, a brief description of the mechanical makeup of the gas-fired unit heater may be in order. Simple in the extreme, it consists fundamentally in an assembly of radiator sections, inside of which the gas is burned, and back of which is an electric fan to force the warmed air out into the space to be heated. No water whatever is used in the gas-fired unit heater, this statement being made to offset a somewhat prevalent opinion to the contrary.

The unit may be controlled automatically by a thermostat, if desired, thus maintaining a uniform temperature, or the control can be by the hand operation of a push button electric switch. Adjustable louvers, or deflectors, for distributing the warm air to the desired section of the space to be heated, are located directly in front of the heat radiator sections. In average service, horizontal louvers only are used but, in special applications, vertical louvers, or a combination of both vertical and horizontal louvers, are available from all manufacturers.

Types of Installations

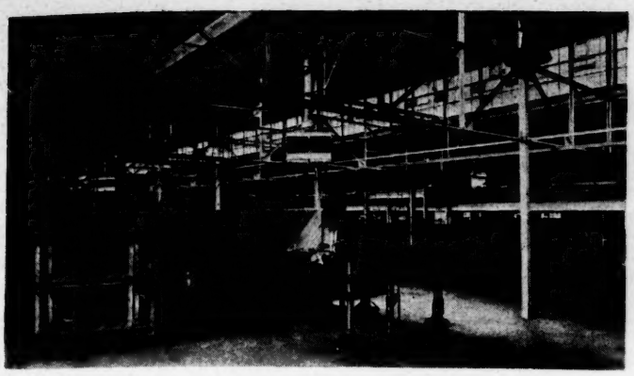
The application of gas-fired unit heaters may be broken down into two broad classifications (1) industrial and (2) commercial.

By industrial is meant the heating of large manufacturing plants, warehouses, and buildings of like



Gas-fired unit heaters in a paper warehouse

†Lay-Out Engineer, Surface Combustion Corp., Toledo, Ohio.



Gas-fired unit heaters in a metal working plant

character. For instance, one of the largest glass manufacturing companies is using 105 gas-fired unit heaters in one of its plants alone. One large foundry is using 48 of them; another foundry 39; one automobile manufacturer 29, and dozens of other automobile manufacturers quite a number of them; a certain large bakery is using 14 in one of its plants. In the general classification of industrial applications, practically all types of industries are represented. Harvesting machinery companies, brake shoe manufacturers, burial vault companies, can manufacturers, sheet metal companies, iron works, stamping companies, motor wheel companies, refrigerator manufacturers, roller bearing companies, electrical manufacturing companies, and many other types might be mentioned.

Special Applications

Not all of the industrial installations are for comfort heating. An example is the case of the warehouse of one of the largest of the steel manufacturers. Due to high humidity, they experienced trouble in their warehouses with the rusting of such steel products as nails. One of the gas-fired unit heater installations is in a building 385 ft. long, 100 ft. wide, and with a maximum ceiling height of 70 ft. Dual automatic controls are employed to protect against high humidity or a sudden drop in temperature. Hundreds of other special applications have been made, as well as the standard applications for comfort heating. Pill manufacturers use them; they increase the output of factories using polishing wheels of an abrasive type; they get printing concerns into quick operation on cold mornings by eliminating the static from the paper stock.

Commercial Field

The so-called commercial field includes thousands of retail business establishments such as grocery stores, department stores, beauty shops, drug stores, filling stations, garages, laundries, men's wear stores, night clubs, restaurants, bowling alleys, hardware stores, and similar places. Many of these have only a few employes and in such establishments having an employe take time out to fire a furnace may be very seriously handicapping the service which should be given to customers.

Just as in the industrial field, there are many special applications in the commercial field. Raisers of chickens for the early spring markets are large users of such equipment. Many such users place the thermostat within a few inches of the floor so as to correspond with the chickens' breathing level. Gas-fired unit heaters are installed in fire departments where the object is not only to give comfort heating but also to keep the motor equipment warm and ready to start at a moment's notice. There are similar installations in many funeral homes, the motor equipment in this case being the ambulances. There are installations in jails, at least one of which is supported by the statement of the prisoner that it is the best heated jail in which he has ever been confined—and his record seems to make that a very broad testimonial. Bingo parlors and liquor stores use them but churches use a far greater number. The world's second largest stadium used them last winter to prevent the freezing of the concrete while a $750,000 addition was being made, then later installed them in the wash rooms.

Field Defined

Contrary to the belief of some of the heating men who have had little experience with unit heaters, there is very little overlapping of the fields between the gas-fired and the steam type unit heaters for industrial work. If the customer already has an efficient steam boiler plant and the distance between the plant and the desired location of the unit heaters is not extensive, then logically the unit heater selected should be of the steam type. On the other hand, if the boiler equipment has not yet been purchased or is so badly worn that it must be replaced, then the installation of gas-fired unit heaters will greatly decrease the initial investment. Operating costs of either type are naturally dependent upon local conditions.

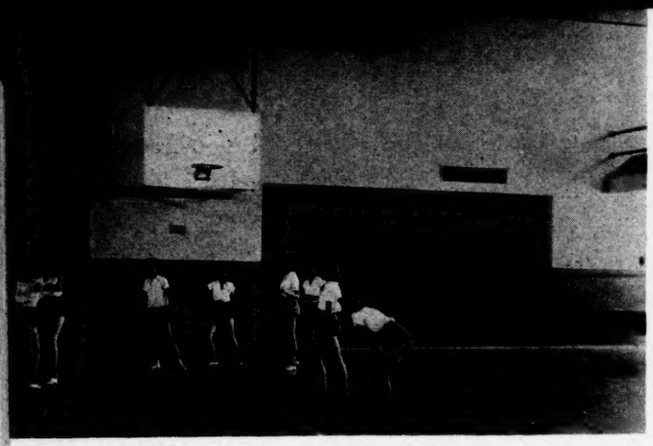
Even when a satisfactory heating plant does exist, there are many possible applications for the gas-fired unit heater to furnish spot or supplementary heating. For instance, if the customer's boiler plant is used for heating purposes only, there are many times when a small amount of heat would be helpful yet that amount is not sufficient to justify operating the large steam boiler. Likewise, there are many times during weekends, holidays, and inventory periods when only a very small part of the establishment is being used. Under such conditions, a few unit heaters of the gas-fired type can show most excellent returns on the investment.

The Volume Market

The commercial market of retail stores and shops is a very attractive one for the gas-fired unit heater. Such installations can be handled satisfactorily by any capable heating salesman, be he engineer or not. The installation of an individual unit heater is a matter of only several hours' time so that the work of the installation does not interfere in any way with the normal operation of the customer's place of business.

The present design of gas-fired unit heaters is firmly established. No radical changes have been made for several years. Such changes as have been shown are largely those aimed at improvements in appearance. In other words, present designs have seen actual operation for a sufficient length of time to prove that they are suitable for the work which is to be done.

Summing up, the gas-fired unit heater has already secured wide national acceptance. It is firmly established and worthy of careful study whenever there is a job for unit heaters.



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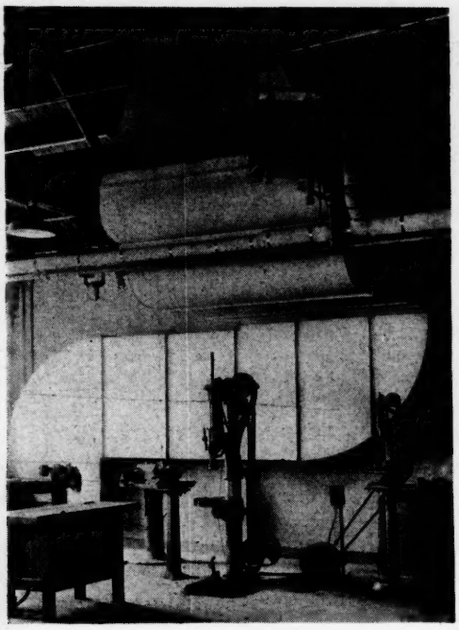

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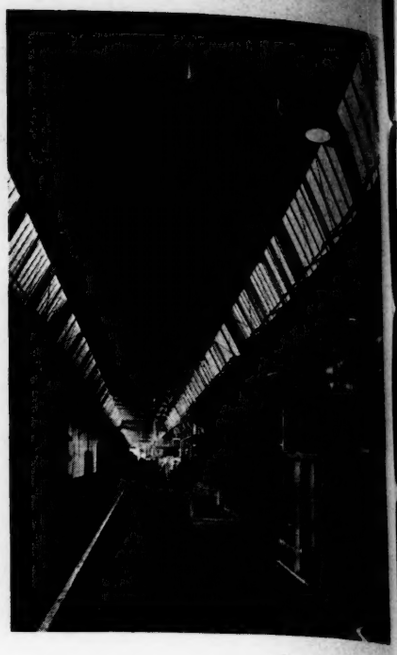

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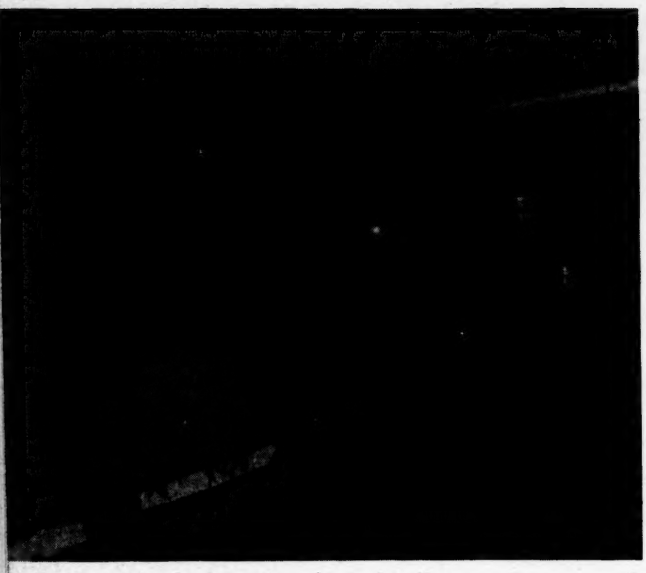

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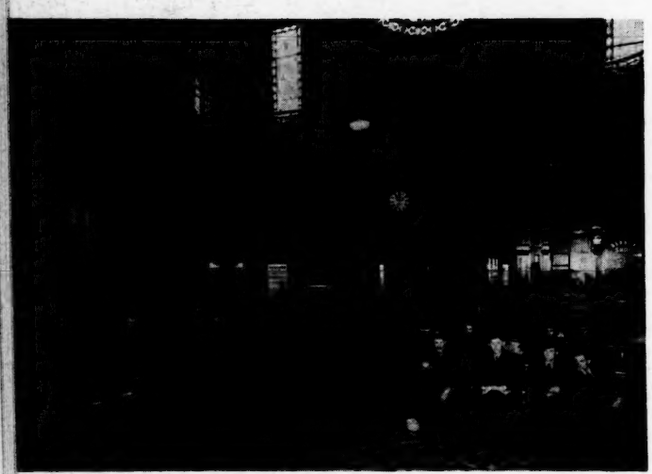
THE WORD IS

1—Gymnasium of the Mesa High School, Mesa, Ariz., showing the grilles connected to the heavy duty unit heater shown in (2). 2—The large centrifugal-blower-type Trane unit heater installed at the ceiling in the machine shop of the high school directly behind the wall of the gymnasium. A propeller-type unit heats the machine shop. 3—This large shipping room is heated by six Buffalo Forge unit heaters mounted high on the ceiling. 4—A Racine tannery was formerly heated by hot air blown by a fan through large distribution pipes. The ductwork took up considerable room, so that the system was finally taken out and Young unit heaters installed as shown. 5—An emergency use for unit heaters. During the 1937 flood in Louisville the heating plant of the L & N Union Station was out of commission. Two large Modine unit heaters were installed above the doors and piped direct to locomotives which supplied the necessary steam for heating. 6—A sheet metal working department of the Scilage Lock Co., San Francisco. Trane projection unit heaters are installed 22 ft. up in the sawtooth of the roof. 7—In the Hygrade Sylvania Company plant, Salem, Mass., heat is distributed by 8 Carrier unit heaters of the suspended centrifugal fan type which serve 32,000 sq. ft. of floor space. 8—An American Blower unit heater installed in a fire house where it not only heats the building but thaws out the hose and dries off the truck following a fire.



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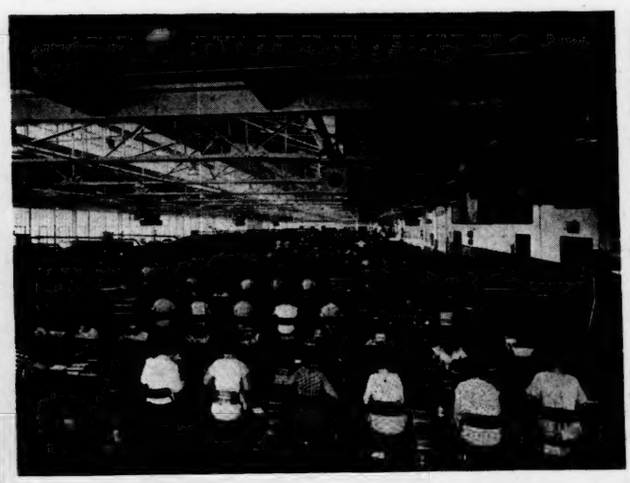

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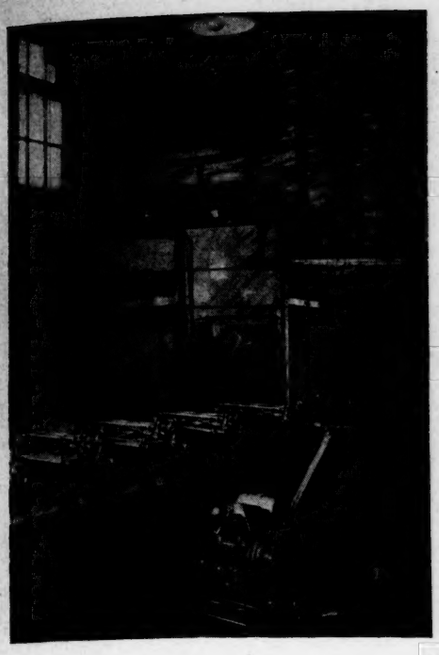

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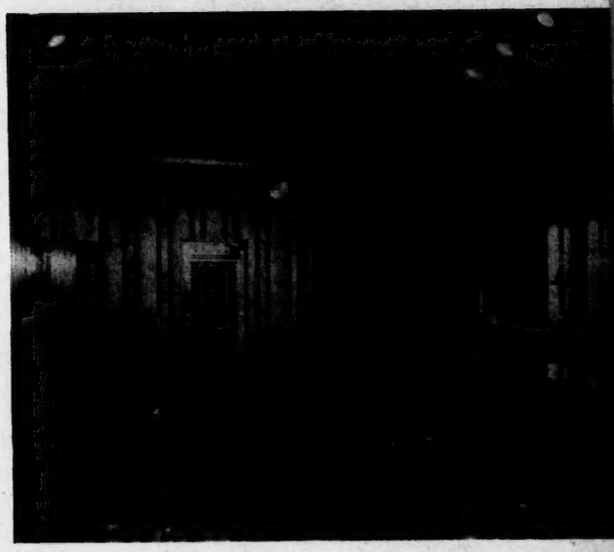
VERSATILITY!

9—A unit heater installation in the paint spray room of a motorized lawn mower plant. The Autovent unit provides quick and even drying following painting operations. 10—Flexibility of unit heaters is illustrated in this view of a large printing establishment where the McQuay unit heater performs double duty. In addition to maintaining comfortable working temperatures, it directs warmed air over the ink supply, keeping the ink at the proper temperature for efficient press operation. 11—The Curtis & Robinson Meat Market, Detroit, Mich., is effectively heated with a Bryant gas-fired unit heater. 12—A tap room in the Jacob Schmidt Brewing Co., St. Paul, Minn., is heated by Wing unit heaters set into the wall with a recirculating duct running to grille at the floor. The grilles are shown above and below the stained glass window. 13—Treatment of the units here is such that they blend in nicely with the decorative scheme. The two McQuay combination heating and cooling units are completely recessed. 14—In this United Fruit Company auction pier in New York, Wing unit heaters eliminated hot and cold spots in a place where, due to the perishables involved, even air temperatures are necessary. 15—Pottery at the J. A. Bauer Co., Los Angeles, is dried with Modine unit heaters at the rate of four tons every 12 hr.—a typical application of unit heaters to drying and processing. 16—An attractive example of disguising an installation of a Modine unit heater.



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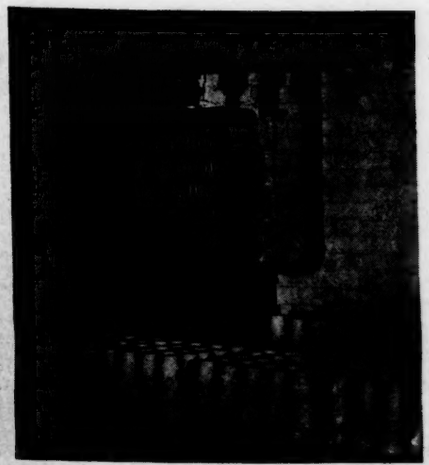

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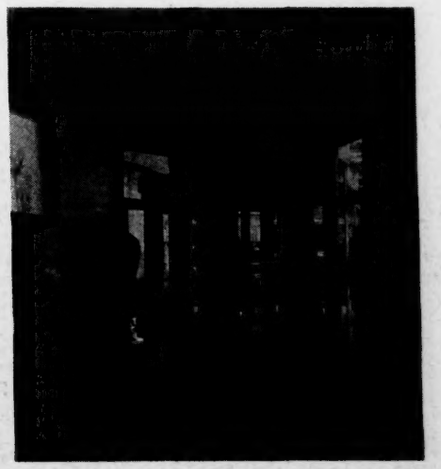

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Steam Piping Connections for Unit Heaters

Getting the steam properly to a unit heater and getting the air and condensate away require suitable piping arrangements and these arrangements must be made with a full understanding of just what is expected of the finished installation. All possible arrangements are too numerous to consider but some of the ones more frequently encountered are diagrammed.

IN connecting unit heaters into a steam supply system it is of first importance to recall that all the heaters must not only work satisfactorily as individual heaters but that the piping leading to and from them, and all the accessory equipment involved, must be so selected and installed that the whole system, which may include direct radiators, coils, stack heaters and a wide diversity of steam consuming equipment, will also be able to function properly. In short, the piping around the unit heaters must strictly conform to the system requirements while at the same time permitting the heaters themselves to function as intended.

It is also important that the heating surfaces be kept free of condensate. This requires that the condensate disposal be rapid for these heaters condense steam rapidly. Among the measures used to accomplish this end is to use traps and disposal pipes of ample capacity. Frequently where traps are used to carry away the condensate they are not only selected of large capacity but a run of several feet of pipe is placed between the discharge opening of the heater and the trap to provide a reservoir where the condensate may accumulate when intermittently operating taps are used, or as a cooling leg when temperature-actuated traps are used. While proper arrangement and careful installation make it possible to use many types of traps at the outlet end of unit heaters, it is common practice to give preference to traps actuated by water level such as bucket or float traps. In general, even though heater manufacturers recommend the use of bucket or float traps for draining the heater element, drainage of drip points in the piping is handled through thermostatic traps, and some installers consistently use thermostatic traps for both locations. This diversity of trapping practice makes it especially desirable to follow the first fundamental in selecting traps, viz: be sure that the trap actually is intended to function under the requirements being imposed on it.

Unit heaters may be attached and fitted into any of the systems of piping in common use for steam heating including one-pipe and two-pipe gravity installations

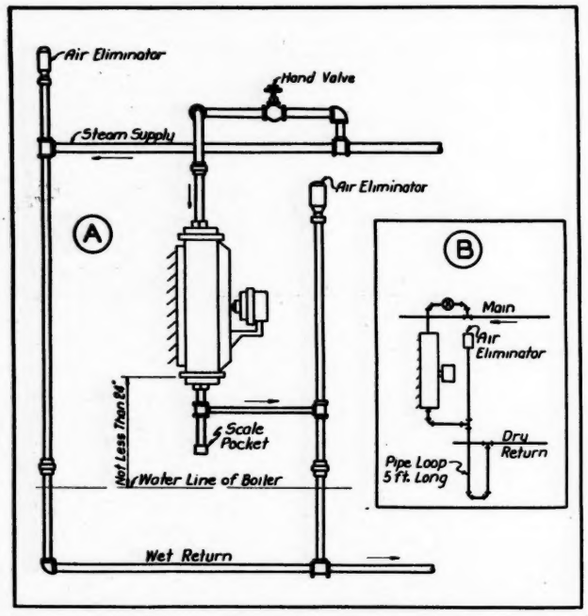


Fig. 1. Method of connecting unit heater to one pipe gravity steam system.

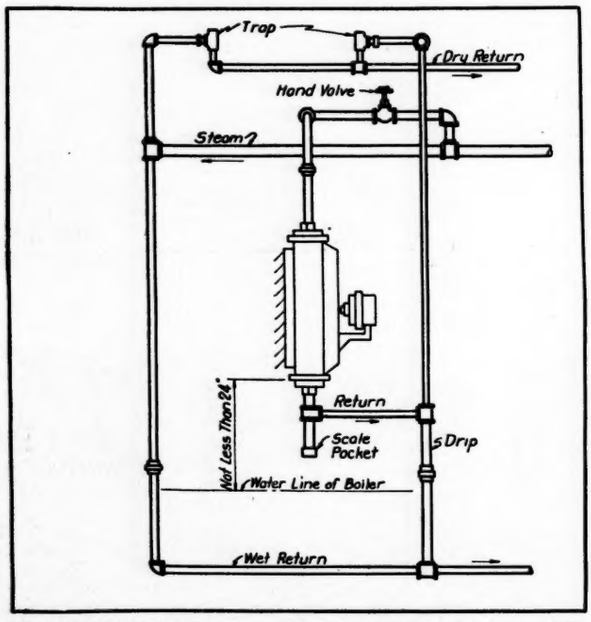


Fig. 2. Unit heater connected to gravity system with wet and dry returns.

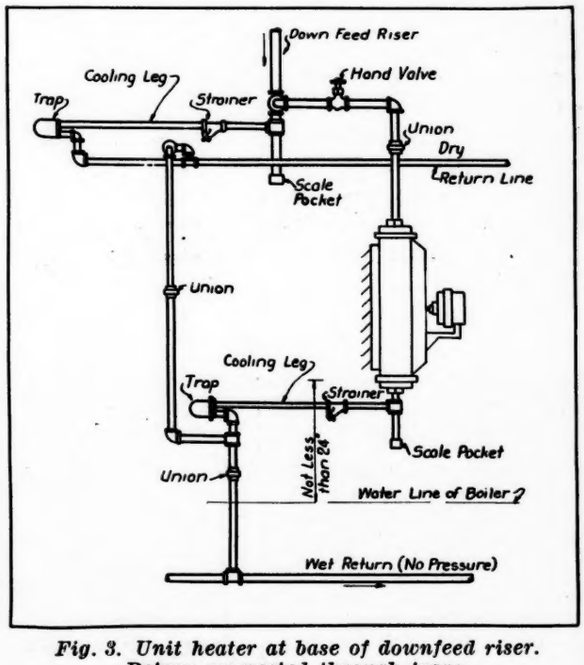


Fig. 3. Unit heater at base of downfeed riser. Return connected through traps.

and vapor systems as well as vacuum systems. It is sometimes stated that unit heaters are not suitable for use with one-pipe gravity and vapor systems but they can be readily used with these systems if pipe connections are arranged with proper care and attention.

As in all cases where piping is being planned for steam heating, it is essential that provision be made for handling both condensate and air, that there be no water-logging of piping, that proper slope is provided, that there is adequate drainage of incidental water, and that good fitting and fabrication practice be followed scrupulously.

The diagrams accompanying this article illustrate piping connections which are frequently used where unit heaters are employed. They are not to scale in any direction and are schematic rather than exact. Screwed pipe fittings are illustrated but welding fittings could equally well be used when desired. While the diagrams are complete enough to suggest good fitting practice it is frequently necessary to change details from those shown in order to secure the necessary allowance for expansion and to avoid physical obstructions. Although a ceiling type propeller-fan heater is illustrated the same connections are used for floor or ceiling centrifugal fan heaters only making such allowances as are necessary due to the changed location of the heater relative to the supply and return mains. Use of suitable traps and accessories is suggested by the sketches, but in all cases if traps are used their characteristics and capacities should be ascertained. It should also be kept in mind that there are other methods of keeping live steam out of returns than by the use of traps and the sketches are not meant to imply that these methods can not be used if desired. Strainers are shown located in the return line in the sketches for the sake of uniformity in presentation. In practice, strainers are frequently located in the supply line leading to the heater rather than in the return line, this being done to protect the heater as well as the trap from dirt. It should be noted that strainers ahead of the trap are not considered necessary when inverted bucket traps drain the heaters. The diagrams actually do not illustrate all the great variety of possible problems or possible solutions where steam-using unit heaters are applied—only enough variety to illustrate the most frequently encountered situations.

Fig. 1. (a) illustrates how a unit heater may be connected to a one-pipe gravity system provided with the customary wet return line. At (b) the principle is shown as a line diagram with the fittings omitted, and where there is a dry return instead of a wet return. Provision of the water pocket is essential in order to prevent steam passing into the return and thus into other equipment. Air elimination is provided both at the end of the supply main and at the heater as is customary in such systems. The figure also shows the lowest location relative to the water line of the boiler at which these heaters should be installed.

Fig. 2 diagrams a method of connection where there is a wet return and a dry return. Here the condensate

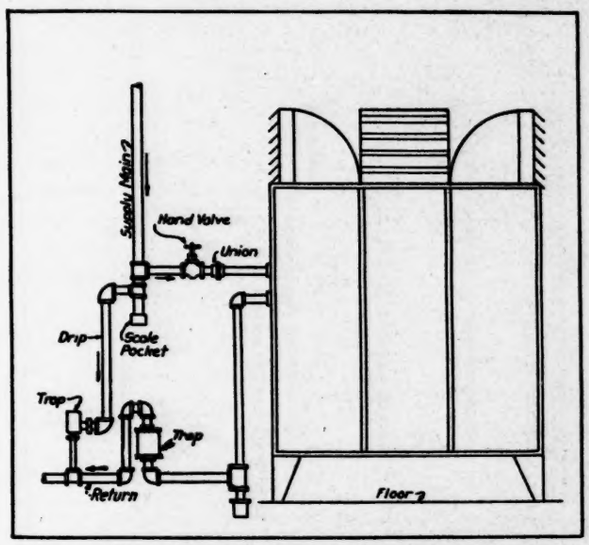


Fig. 5. Floor type unit heater showing similarity of connection with that shown in Fig. 4.

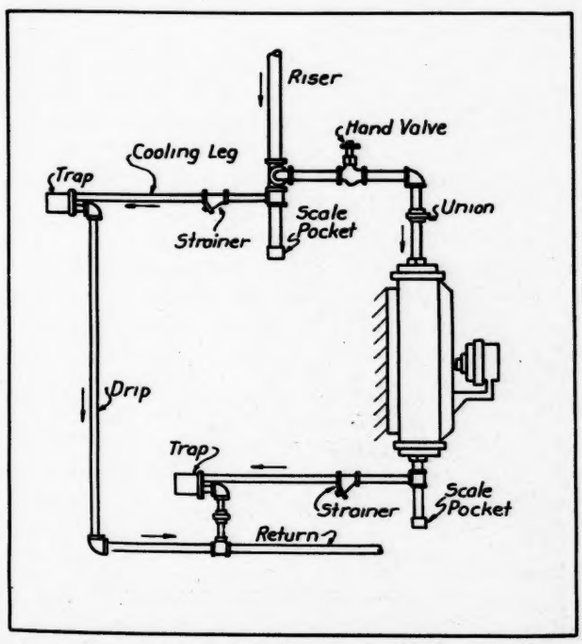


Fig. 4. Unit heater at base of downfeed riser with main above and return below.

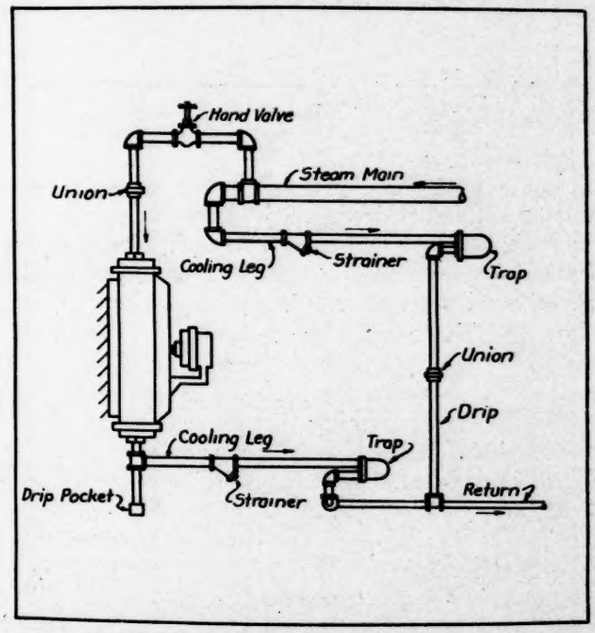


Fig. 6. Unit heater on vacuum system or vapor system discharging condensation into dry return or return line to condensate pump.

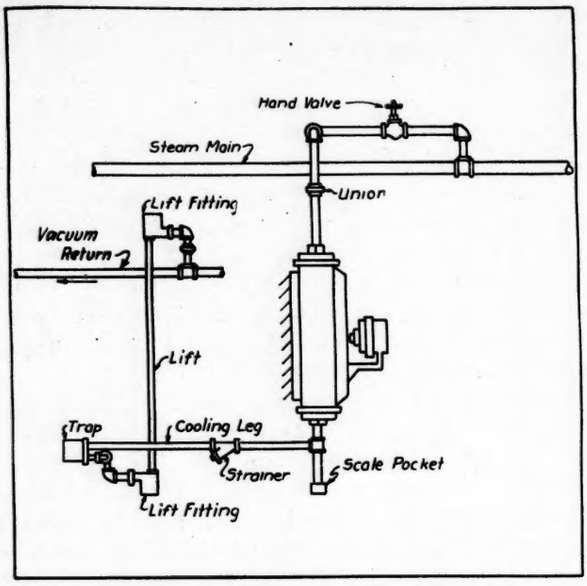


Fig. 7. Unit heater connected to vacuum system with supply and return both above.

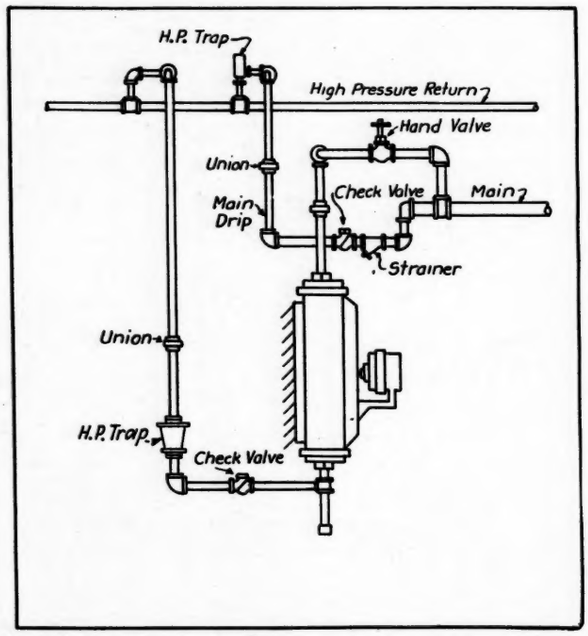


Fig. 8. Method of connecting unit heater on high pressure return above unit heater.

from the heater and the drip from the supply main drop to the wet return by gravity while the air passes upward through the traps to the dry return and is vented from the system at any suitable location. The sketch also shows that the lowest heater should be high enough above the boiler water line to keep free of water when the maximum operating pressure difference is present in the ends of the system. It will be observed that the principle of the water loop is preserved in this sketch.

The piping in Fig. 3 closely resembles that shown in Fig. 2 but the condensate and drip both pass through steam traps on their way to the wet return. The air also passes through the traps illustrated and these must be of a type capable of handling both air and water.

Figs. 4 and 5 show steam being supplied by a down-feed riser from a main above while the return main is located below the heaters. The riser is dripped to the return through a trap while the condensate from the

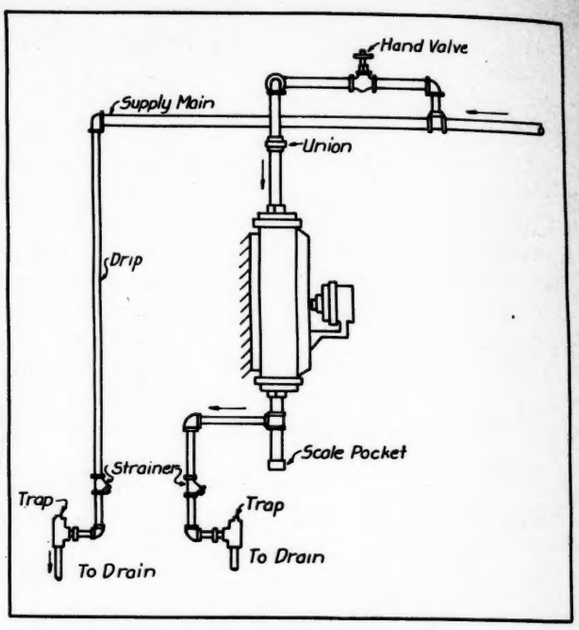


Fig. 9. Method of connecting unit heater on high pressure. Condensation wasted.

heater passes to the return through a separate trap. This plan, since the heaters are not vented, must allow for both air and condensate to be handled through the traps and passed to the return. Connections of this kind may be regarded as typical of vacuum return line systems of steam heating. The two figures illustrate well that the same connections may be used generally with either ceiling or floor heaters.

Fig. 6 is a sketch of an arrangement where there is a dry return line through which both air and condensate pass to be handled by some suitable means, such as a condensation pump and receiver. The return line is not under vacuum and consequently all arrangements must facilitate gravity flow of the condensate toward the receiver. Traps must pass air and condensate rapidly to keep the return piping only partially full of water.

A case frequently encountered is that shown in Fig. 7. Here a vacuum return line system has both the supply and the return main located above the heater. It is necessary to raise the condensate and air in order to get them into the vacuum return main. Resort is had to the familiar device of the lift fitting to accomplish this. The steam main can be dripped into the vacuum return line in the usual manner and consequently this connection is not shown on the sketch.

Since unit heaters are so often constructed with sufficient strength to resist high pressures, use of high pressure steam in them is a common practice. Figs. 8 and 9 relate to high pressure practice. In Fig. 8 the condensate and air reach the overhead return through traps, and check valves are located in the return piping. In Fig. 9 the high pressure steam is not sent to a return line but is wasted to the drains or to the atmosphere. Traps for high pressure work must be carefully selected to insure that their operating characteristics are those desired. Another point in planning high pressure application is to avoid any layout of piping whereby condensate from high pressure is led into low pressure return lines unless adequately cooled to avoid re-evaporation at the low pressure.

They Must Be Silent

By MARVINE GORHAM, Jr.†

UNTIL a few years ago, a unit heater was considered as an instrument to throw heat at specified angles about a work shop or factory where the existing noise level was already so high that the additional noise made by a unit heater was not considered important. Since then, however, the application of unit heaters in department stores, auditoriums, and offices has required that new designs can no longer sound like a "concrete mixer." They must be silent.

A discussion of how silent a heater must be would involve the measurement of noise and would require volumes rather than pages. Therefore, this paper will deal in methods for quieting heaters, stating only the final results rather than the results obtained from each improvement.

The motor manufacturers have recently brought out a development which has been a joy to everyone trying to silence unit heaters. One of the frequent causes of noise in the past was the beat or rhythmic whine caused by surge in current frequence or variance in line voltage. This, together with the rest of the small motor noises such as brush noise and magnetic hum, disappeared when resilient mountings were developed. Rubber or spring mountings are not available on larger motors but in most cases where it is necessary to have a silent unit heater installation, the small, fractional horsepower motor is the one that is used. Thus the motors used on unit heaters have become virtually silent, eliminating one of the greatest troubles of the past.

Consequently, the electrical noises are beaten. This brings up the mechanical troubles of which there are many. Not all flexible couplings are silent. Bearings are frequently a source of considerable noise. It has been found that, in general, sleeve bearings are more silent than either ball or roller, and if care is taken to pick out a sleeve bearing that is silent on the particular heater in question, there should be no further trouble. In all cases, considerable racket can come from loose bearing collars, tie rods and shaft keys.

Here is a good point to bring up, the importance of sturdiness in the construction of the heater casing, the fans and the rest of the composite parts that go to make up the complete unit. Throughout this discussion it has been assumed that all revolving parts are in perfect balance. The finest balancing machines will not do a 100% job in production methods, with the result that the rotating parts will be slightly out of balance. This error may be only minute, but it nevertheless sets up a vibration that can be taken up only in the frame upon which the rotor assembly rests. If this is a light gage metal, it will not absorb this vibration properly and the net result will be that all the nuts, bolts, and rivets or welds in the heater will loosen up, creating the most annoying kind of noises, the greatest of which will be when the heater falls on the floor in a heap. This is important. For example, imagine a slight vibration such as an electric buzzer on an ordinary drum-head made of a thin tightly stretched skin. It would be magnified many times. Now imagine the same vibration on the same drum-head but this time it is made out of a thick cowhide. Of course, the noise in the second case is much less. The same applies to unit heaters. The thinner the gage of metal used, the greater the noise from all sources will be.

The air noises are the next to take into consideration. If air has a given velocity and then is made to change that velocity in either amplitude or direction noise will be created. This is the basis of all air noises in unit heaters. It must be realized that the less violent the change of the velocity of the air the less noise there will be. Thus, the idea in every case is to smooth over all obstructions and to make all corners and bends around which the air must go as gradual as possible. For example, the inlet cone on any type of fan should be rounded so that the air from outside is not suddenly snapped from a dead standstill up to top speed. Instead it comes up to speed gradually and flows into the inlet and through the wheel.

In the wheel, there is the greatest chance for noise-creating air disturbance. The air motion must be changed from smooth flow to a spiral flow during which time it is constantly being churned up by the blades of the fan itself. The design of the blades is an important factor. The original requirement is that the blades paddle the air along; yet from the noise angle the requirement is that the blade shall pass through the air with as little commotion as possible. To design a blade which will strike this happy medium of maximum efficiency with minimum noise is an art.

The cut-off, or point in a centrifugal fan where the air starts away from the wheel is the point where the air is traveling fastest and also the point that is closest to the blades of the wheel. It is at this point that noise may easily develop if the design is not correct and if all the rough edges are not eliminated. In the coils there are also chances for the creation of noises, but in this case, as in all the others above, the object is to smooth over all projections and to make all shapes that are in the moving air conform to its natural flow. A perfectly streamlined object will make as little noise as is possible when put in a stream of air.

To summarize: First build the heater well, of good material from a correct design. Second, smooth out the joints in the fan as well as in any inlet or outlet ductwork. Third and last, guarantee the absence of vibration noises by mounting on resilient material, and insulating any ductwork on the inside with some sound-absorbing material.

†Buffalo Forge Company.

Operation of Evaporative Condensers

By H. C. ROOKS†

THE use of evaporative condensers is rapidly becoming widespread. With this wide use, more questions are being asked about the details of its operation. A lively curiosity is being exhibited by users about such details as the condensation process, coil design, and subcooling. In this article, these questions, among others, will be answered in a simple manner.

There are a number of familiar forms of condensers. The shell-and-tube condenser using a continuous supply of water is one. Another is the shell-and-tube condenser used in conjunction with a cooling tower—the condenser cooling water being continually circulated between the two. The evaporative condenser incorporates a condenser and cooling tower into one compact unit.

The evaporative condenser consists primarily of a coil over which water is sprayed, with air drawn over the wetted coil surface by a fan. A pump takes the water from a pan at the bottom of the unit and sprays it over the coil. The refrigerant flows through the inside of the tubes.

The heat that the refrigerant loses passes through the walls of the tubes to the spray water on the outside of the coil. This heat evaporates some of the spray water into the air flowing through the condenser. Thus, the heat surrendered by the refrigerant appears as latent heat in the air. The two steps—the transfer of heat from the refrigerant to the spray water, and the evaporation of the spray water into the air stream—will be considered separately.

Heat Transfer from Refrigerant to Spray Water

The transfer of heat from the refrigerant to the spray water can be compared to the familiar problem of the transfer of heat through the wall of a building. The resistance to heat flow due to the air film on the inside surface of a wall is similar to that of the refrigerant film on the inside of the tube. The resistance of the building wall is comparable to the resistance of the tube and fins. The effect of the air film on the outside of the building wall is similar to the effect of the film of spray water on the outside surface of the coil. In both cases, the flow of heat is caused by the difference in temperature. In the evaporative condenser, the flow of heat is caused by the difference in the temperature between spray water and the refrigerant. When the temperature difference is increased, the heat removal from the refrigerant is also increased for a given amount of surface. The conductance of heat through the wall of the tube is so high compared to the lower conductance of the water film that it can be neglected. The fin design, however, materially affects the total transfer to the spray water and is discussed later.

For a condenser to operate satisfactorily, it is essential that the coil should be completely wetted by the spray water. As previously noted, the heat is transferred from the refrigerant to the spray water. Therefore, if a part of the coil is dry, the capacity of the coil will be materially reduced.

In addition to this, the continued satisfactory operation of the unit over a period of time is dependent upon having a clean coil, the fins and tubes being free of dirt. Sufficient water should be sprayed over the coil to insure thorough washing of the exposed surfaces.

Heat Transfer from Spray Water to Air

The heat surrendered by the refrigerant to the spray water is in turn transferred from the spray water to the air by the evaporation of a small part of the spray water itself into the air. The evaporated water is carried away by the air flowing through the unit, thereby increasing the wet bulb temperature of the air. The rate of evaporation, or in other words, the rate of heat transfer from the spray water to the air depends on the difference between the temperature of the spray water and the wet bulb temperature of the air. The greater this temperature difference is, the greater will be the rate of evaporation, or heat transfer, from the spray water to the air. Obviously for evaporation to take place, the wet bulb temperature of the air must be lower than the temperature of the spray water.

Temperature Variations in the Evaporative Condensers

Fig. 1 shows diagrammatically the temperatures at various points in an evaporative condenser. Temperature changes of the air wet bulb, spray water, and refrigerant are noted both in the coil and in the space

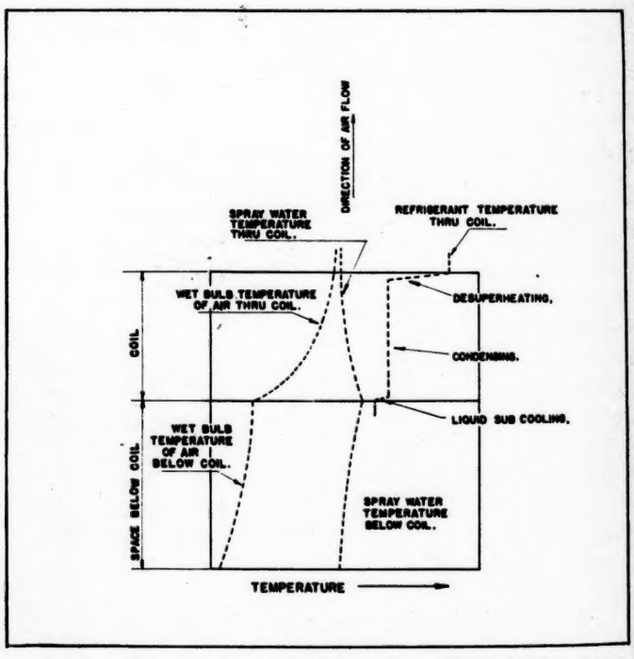


Fig. 1. Temperature relation of the three fluids—air, water, and the refrigerant—in an evaporative condenser

†The Trane Co.

below it. As the air in passing through the evaporative condenser absorbs all the heat given up by the condensing refrigerant, it is possible to calculate the leaving wet bulb of the air if the load on the condenser is known. In cooling air, for example, it is possible to determine the total load on a cooling coil by multiplying the quantity of air handled by the difference in the total heat of the air entering and leaving the coil. In a similar fashion, knowing the condensing load, it is possible to determine the wet bulb of the air leaving an evaporative condenser. Dividing the total load by the air quantity gives the change in total heat of the air while passing through the condenser. Adding this difference to the total heat of the air entering the condenser gives the total heat of the leaving air.

The temperature of the spray water on the coil depends not only upon the temperature of the refrigerant and the wet bulb of the air but also upon the heat transfer from the refrigerant to the spray water and from the spray water to the air. For example, if there were no resistance to the flow of heat from refrigerant to the spray water, the temperature of the spray water and the refrigerant would be the same. However, as there actually is some resistance, the temperature of the spray water will be lower than the temperature of the refrigerant. Also because of the resistance to the evaporation of moisture into the air, the temperature of the spray water will be higher than the wet bulb temperature of the air. In any given condenser, the resistance to heat transfer are constants for a given set of operating conditions. The spray water will, therefore, reach an equilibrium temperature which lies at some point between the temperature of the refrigerant and the wet bulb temperature of the leaving air.

So far, the spray water temperature has been referred to as though it were constant throughout the unit for a given set of conditions. This constant temperature is the average spray water temperature used in calculating the capacity of the unit. Actually there is a slight variation in the temperature of the water during its travel through the unit. The water first comes in contact with the warm condensing coil and the relatively warm air. Below the coil, however, it comes in contact with the cool entering air. As a result of its contact with the cool entering air below the coil, the temperature of the water drops slightly as shown in Fig. 1.

The change in water temperature depends upon the length of time that the water is in contact with the air below the coil. As the vertical distance from the bottom of the coil to the air inlet is usually small, the water is not in contact with the air for a long enough time to appreciably affect its temperature. Theoretically, there would be no variation in the temperature of the spray water if the space below the coil could be eliminated.

As a result of the temperature drop below the coil, the temperature of the spray water rises slightly as it is sprayed over the coil again.

The temperature variation of the refrigerant as it passes through the evaporative condenser is also illustrated by Fig. 1. When the gaseous refrigerant enters the condenser it is superheated. The removal of this superheat takes place in the first portion of the top

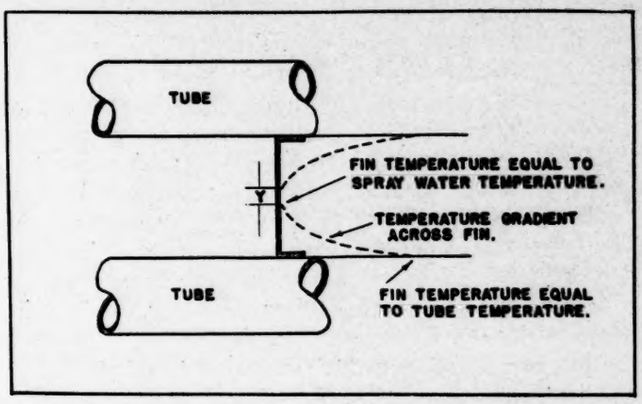


Fig. 2. Effect of fin construction on coil performances.

row of tubes in the condenser coil, and is only a relatively small portion of the total load on the condenser. After the superheat has been removed, the latent heat removal begins and condensation takes place. This action usually continues down to the lower tubes, at which point all of the gas has been condensed and subcooling takes place. The amount of subcooling depends on the spray water temperature. The leaving liquid temperature will always be at some point above the temperature of the spray water.

Liquid Cooling with an Evaporative Condenser

It is frequently advantageous to cool a liquid with an evaporative condenser. When used for this purpose, the operation of the unit is basically the same as previously described for condensing a vapor; the only difference being that the fluid within the tubes is continually dropping in temperature as it surrenders its heat. Evidently the temperature of the liquid within the tubes can be lowered only to some point slightly above the temperature of the spray water. As the temperature of the spray water cannot be lower than the wet bulb temperature of the leaving air, it is evident that the temperature of the liquid refrigerant leaving the condenser cannot be lower than the leaving wet bulb temperature.

As a result, if it is necessary to cool a liquid to a temperature of, say, 95F, the leaving wet bulb cannot be much above 90F. With an assumed entering air wet bulb of 80F, the maximum amount of heat that can be removed by a 1000 c.f.m.-unit is 51,750 B.t.u. per hr. If, however, the leaving liquid temperature is 105F and the leaving wet bulb 100F, the total capacity of the 1000-c.f.m. unit will be 117,675 B.t.u. per hr.; in other words, more than doubled.

It is evident from this example that although the heat transfer coefficients and the amount of external surface are important, the temperature to which the liquid leaving the condenser must be cooled determines the maximum capacity of a condenser used for this purpose.

Finned Coils

From the foregoing, it is evident that the heat transfer characteristics of a coil in an evaporative condenser are entirely different from those encountered in dry air heating or cooling work. The quantity of heat removed per square foot of external surface is consider-

ably greater in the evaporative condenser coil due to the higher heat transfer coefficients. This increased heat transfer has a direct bearing on fin construction.

The total amount of external surface in an evaporative condenser coil is no indication of the capacity of the unit unless the ratio of prime to secondary surface and the method of coil construction are also known.

The overall coefficients of dry heating coils cannot be used to compute the capacity of an evaporative condenser in which the surface is continually covered by a relatively large quantity of spray water. This is illustrated by the following discussion.

If a copper rod is heated at one end and the other end is immersed in a stream of cold water, heat will be transferred from the rod to the water so rapidly that there will be a sharp drop in the temperature of the portion of the rod beneath the surface of the water. The immersed portion of the rod will be at approximately the water temperature. Most of the heat is removed from the rod in a very short distance below the water surface. If, however, the same rod is inserted into a stream of air, the drop in the temperature of the rod will be considerably less than when it was immersed in the water. This is due to the fact that the heat cannot be removed from the rod by air as rapidly as by water.

When used in evaporative condenser work, a fin suitable for air cooling work will have a temperature gradient similar to that of the copper rod immersed in water. This effect is shown in Fig. 2. The heat removal from the wet fin is rapid enough to reduce the temperature of the fin substantially. The portion of the fin midway between the tubes, marked "Y" in Fig. 2, is practically at the spray water temperature. This portion of the fin, as a result, is comparatively ineffective. A fin design which is suitable for dry air work is, therefore, not always suitable for evaporative condenser work. To remedy this, it is necessary to reduce the spacing between the tubes in a continuous fin, or reduce the length of the fin in the case of individual fins. By doing so, the ineffective portion "Y" can be eliminated. Essentially this reduces the ratio of secondary to prime surface.

Because of the large amount of external surface per foot of tube length in a finned coil, a much shorter length of tubing is required if fins are used than if the tube is bare. Heat is removed by the fins and this reduces the amount of prime tube surface required. Because of the temperature gradient in the fin, the amount of heat transferred per square foot of external surface is less with a fin coil than with a bare tube coil. Due to the large amount of external surface per foot of tube length, the total space required for a coil with fins is much less than that of the bare type as practically the same tube centers can be used for either a fin coil or bare tube coil. Space, however, is not the only criterion; in the final analysis, the problem is primarily one of cost per ton of refrigeration capacity.

Converting from Round to Rectangular Ducts

PRACTICALLY all information on friction loss in ducts is presented for round ducts. In order to find the frictional loss of rectangular ducts it is necessary to determine the size of a round duct which has the same frictional resistance and then use this to determine the frictional loss.

In converting from rectangular to round ducts it should be understood that there are two round ducts which have the same frictional loss as a rectangular duct. If the velocity of the air is kept constant the round duct size obtained will be different from the size obtained when the air quantity is constant. Just which duct is selected depends upon whether the duct system is being designed to maintain a given air velocity or to deliver a given amount of air.

Exhaust duct systems constructed to carry solids such as wood shavings or lead dust are designed to maintain a given air velocity in order to carry the solids. In these systems the air quantity delivered is secondary to the air velocity. In designing these systems the formula for converting from rectangular to round ducts is

$$D = \frac{2ab}{a + b} \quad \textit{(equal velocities)}$$

Where

D is the diameter of the round pipe
a is one side of the rectangular duct
b is the other side of the rectangular duct

Example: What size round duct has the same frictional resistance as a 12 × 20 in. rectangular duct assuming equal velocities in each duct?

$$D = \frac{2 \times 12 \times 20}{12 + 20} = \frac{480}{32} = 15 \text{ in.}$$

Duct systems constructed to carry air for heating, cooling, or ventilating purposes are designed to deliver a constant amount of air and in these systems the air velocity is secondary to the air quantities. The formula for converting from round to rectangular ducts in this case is:

$$D = 1.265 \sqrt[5]{\frac{(ab)^2}{a + b}} \quad \textit{(equal quantities)}$$

Because of the complication of this formula the information is usually arranged in the form of tables which make it unnecessary to solve the formula. One such table appeared in the March, 1938 issue of HEATING & VENTILATING on page 47.

Example: What size round duct has the same frictional resistance as a 12 × 20 in. rectangular duct assuming equal air quantities in each duct?

$$D = 1.265 \sqrt[5]{\frac{(12 \times 20)^2}{12 + 20}} = 1.265 \sqrt[5]{\frac{(240)^2}{32}} = 17 \text{ in.}$$

Highest Temperatures of Record

The accompanying map and table are devoted to data on the highest temperatures ever recorded at official weather stations. The table covers 100 of the largest cities, while the map is based on readings from a very large number of stations and is a simplification of an official Weather Bureau map. The map is believed to be substantially correct through 1933.

High Temperature Not Always Peak Load

While the highest temperatures of record are of interest to the air conditioning engineer they do not have nearly the relative importance that the lowest temperatures of record have. The reason for this is that the sensible heat load of the system resulting from the dry-bulb temperature conditions may be so small as compared with other sensible and latent heat loads that the peak load of the plant may occur at some time other than that when the dry-bulb temperature is at its peak. The wet-bulb temperature, sun, and interior heat in the building are frequently of more concern to the engineer than the extreme dry-bulb temperature. However, the highest temperature of record should be taken into account and data on this phase of air conditioning design are printed here in the table and accompanying map.

High Temperatures Vary Little

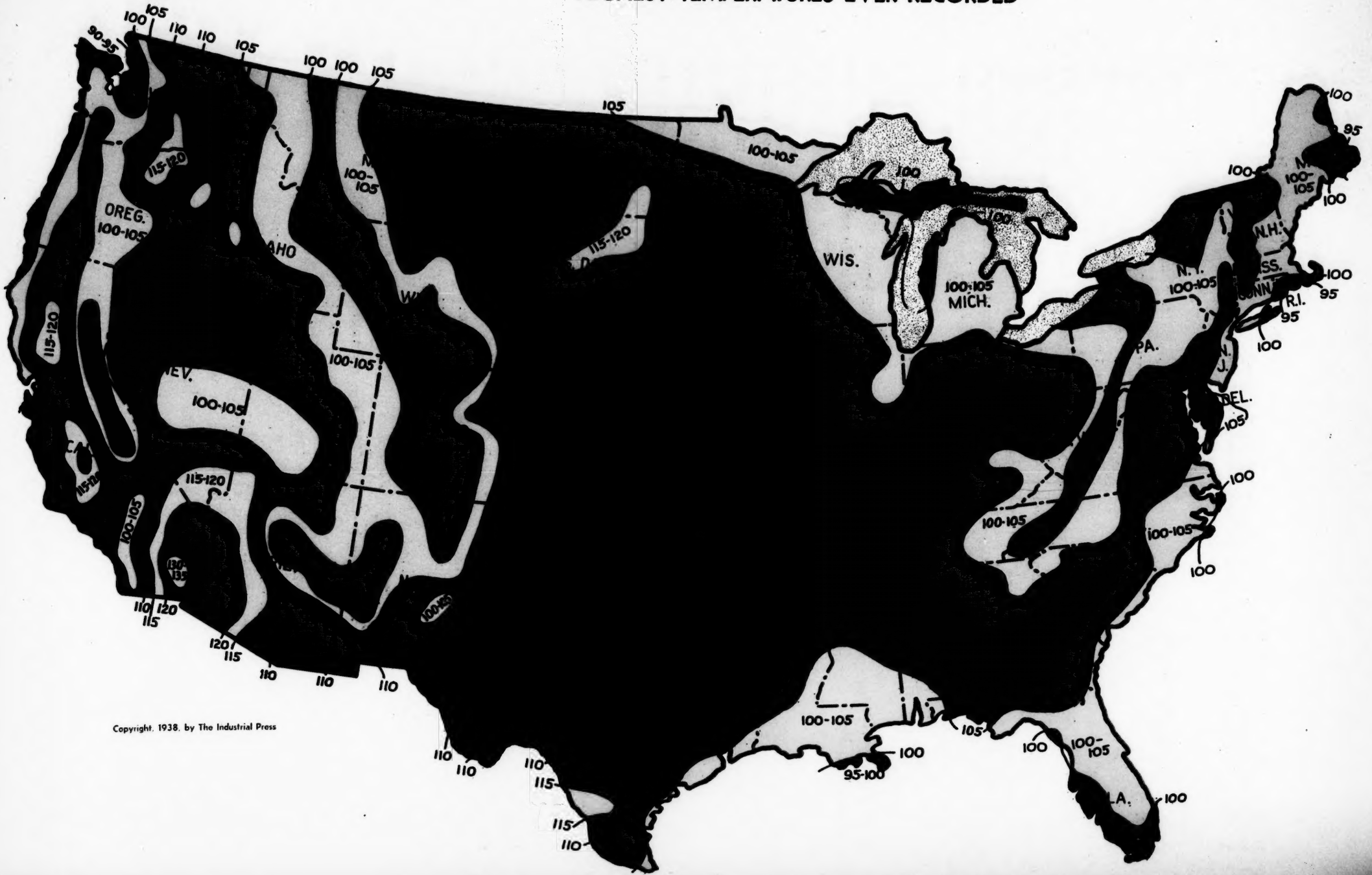
There is less difference between record highs in various sections of the United States than between record low temperatures. Table A shows the extreme temperature for nine cities in various parts of the country. The average record high of these cities is 107F. The average deviation of the highest high and of the lowest high from this average is 15F. The average of all the lowest temperatures of record of these cities is —10F and the average deviation of the lowest low and the highest low from this average is 39F, showing that there is more variation in extreme lows than in extreme high temperatures.

Range of Extremes

Table A also shows the range between the two extremes of temperature for nine cities in widely separated parts of this country. The relatively low range between high and low temperatures in

Text continues following Map and Table.

HIGHEST TEMPERATURES EVER RECORDED



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HIGHEST TEMPERATURE EVER RECORDED IN 100 CITIES

City	Highest Temp., F
Albany, New York	104
Albuquerque, New Mexico	104
Atlanta, Georgia	103
Baltimore, Maryland	107
Birmingham, Alabama	107
Boise, Idaho	121
Boston, Massachusetts	104
Buffalo, New York	95
Burlington, Vermont	100
Butte, Montana	100
Charleston, South Carolina	104
Charlotte, North Carolina	103
Cheyenne, Wyoming	100
Chicago, Illinois	105
Cincinnati, Ohio	108
Cleveland, Ohio	100
Columbia, South Carolina	106
Columbus, Ohio	106
Concord, New Hampshire	102
Dallas, Texas	105
Denver, Colorado	105
Des Moines, Iowa	110
Detroit, Michigan	104
Duluth, Minnesota	106
El Paso, Texas	106
Erie, Pennsylvania	97
Eugene, Oregon	104
Evansville, Indiana	108
Fitchburg, Massachusetts	103
Flagstaff, Arizona	99
Fort Smith, Arkansas	110
Fort Wayne, Indiana	106
Frederick, Maryland	108
Grand Forks, North Dakota	108
Grand Rapids, Michigan	103
Great Falls, Montana	107
Greensboro, North Carolina	104
Hartford, Connecticut	101
Houston, Texas	108
Huntington, West Virginia	108
Indianapolis, Indiana	106
Jacksonville, Florida	104
Kansas City, Missouri	111
Knoxville, Tennessee	104
Lexington, Kentucky	104
Lincoln, Nebraska	112
Little Rock, Arkansas	108
Los Angeles, California	109
Louisville, Kentucky	107
Madison, Wisconsin	104
Memphis, Tennessee	106
Meridian, Mississippi	105
Milwaukee, Wisconsin	105
Minneapolis, Minnesota	108
Minot, North Dakota	109
Mobile, Alabama	103
Newark, New Jersey	105
New Orleans, Louisiana	102
New York, New York	102
Norfolk, Virginia	105
Oklahoma City, Oklahoma	109
Omaha, Nebraska	111
Paterson, New Jersey	104
Pensacola, Florida	103
Peoria, Illinois	114
Philadelphia, Pennsylvania	106
Phoenix, Arizona	118
Pittsburgh, Pennsylvania	103
Portland, Maine	103
Portland, Oregon	105
Providence, Rhode Island	100
Pueblo, Colorado	104
Reading, Pennsylvania	105
Reno, Nevada	106
Richmond, Virginia	107
Rochester, New York	101
St. Louis, Missouri	110
Salt Lake City, Utah	105
San Antonio, Texas	107
San Diego, California	110
San Francisco, California	101
Savannah, Georgia	105
Scranton, Pennsylvania	102
Seattle, Washington	98
Shreveport, Louisiana	110
Sioux City, Iowa	111
Sioux Falls, South Dakota	110
South Bend, Indiana	109
Spokane, Washington	108
Springfield, Illinois	110
Syracuse, New York	100
Topeka, Kansas	112
Trenton, New Jersey	105
Tulsa, Oklahoma	113
Vicksburg, Mississippi	104
Washington, Dist. of Col.	106
Wheeling, West Virginia	110
Wichita, Kansas	111
Wilmington, Delaware	107
Yuma, Arizona	120

Los Angeles is accounted for by the effects of the Japan current flowing from the north along the western coast, while the mountains account for Butte's wide range of temperature.

Record Highs by States

Table B below shows the highest temperatures on record by States covering the period up to and including the year 1933. The highest temperature ever recorded in the United States was 134F at Greenland Ranch, Death Valley, Calif., July 10, 1913.

TABLE A—EXTREMES OF TEMPERATURE IN VARIOUS CITIES.

	Lowest of Record, F	Highest of Record, F	Range
Los Angeles	27	109	82
Buffalo	—14	95	109
Yuma	22	120	98
Butte	—52	100	152
Duluth	—41	106	147
New Orleans	7	102	95
Jacksonville	10	104	94
Ft. Wayne	—24	106	130
Boise	—28	121	149
Average	—10	107	117
Deviation from Average	39	15	35

TABLE B—HIGHEST TEMPERATURE EVER RECORDED BY STATES, F.

Alabama	112	Maine	106	Ohio	113
Arizona	127	Maryland	110	Oklahoma	118
Arkansas	116	Massachusetts	106	Oregon	119
California	134	Michigan	110	Pennsylvania	108
Colorado	115	Minnesota	114	Rhode Island	100
Connecticut	105	Mississippi	115	South Carolina	111
Delaware	110	Missouri	116	South Dakota	117
Florida	109	Montana	113	Tennessee	113
Georgia	111	Nebraska	115	Texas	119
Idaho	116	Nevada	122	Utah	116
Illinois	115	New Hampshire	104	Vermont	104
Indiana	113	New Jersey	109	Virginia	109
Iowa	113	New Mexico	116	Washington	118
Kansas	116	New York	108	West Virginia	112
Kentucky	114	North Carolina	108	Wisconsin	111
Louisiana	112	North Dakota	124	Wyoming	116

Alternating Receivers for High Pressures

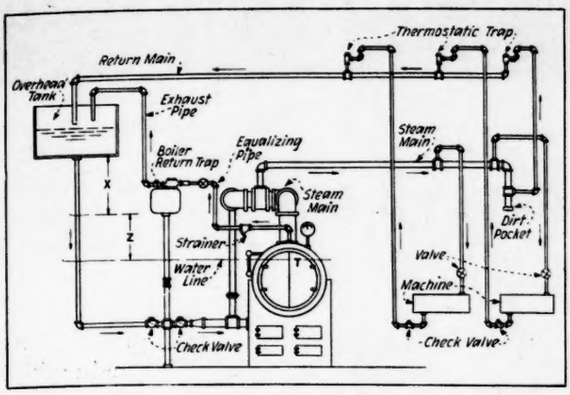


Fig. 1. Alternating receiver connected to a high-pressure boiler.

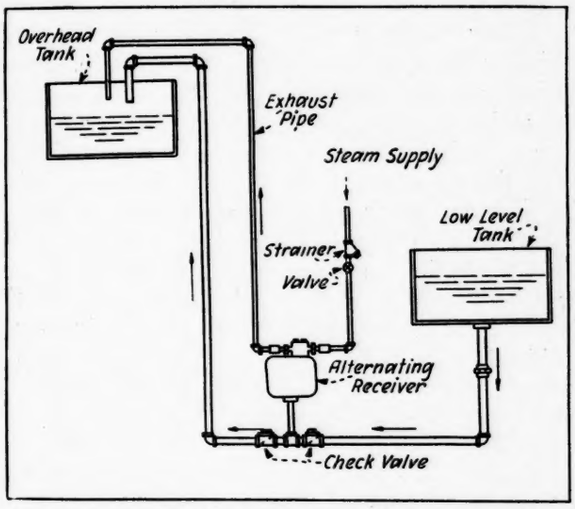


Fig. 2. Alternating receiver elevating water only.

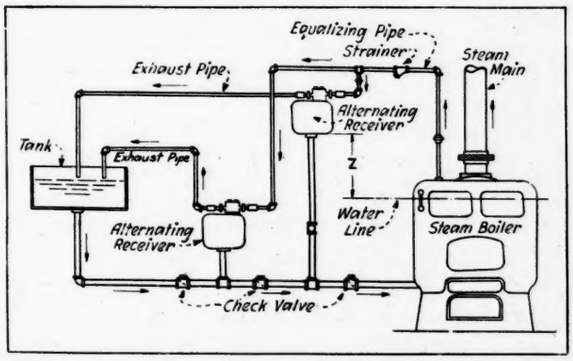


Fig. 3. Two alternating receivers in series elevating and discharging water into boiler.

IN a previous article in last month's issue attention was directed toward the alternating receiver as applied to returning the condensate into the boiler in low-pressure heating systems. As a matter of fact alternating receivers are frequently employed for many purposes besides discharging condensate into a low-pressure steam boiler. A few of these adaptations of this very useful device are illustrated here.

Alternating receivers are now constructed for high steam pressures and can be used for feeding high-pressure boilers, or elevating water into overhead tanks. Fig. 1 illustrates an alternating receiver connected to

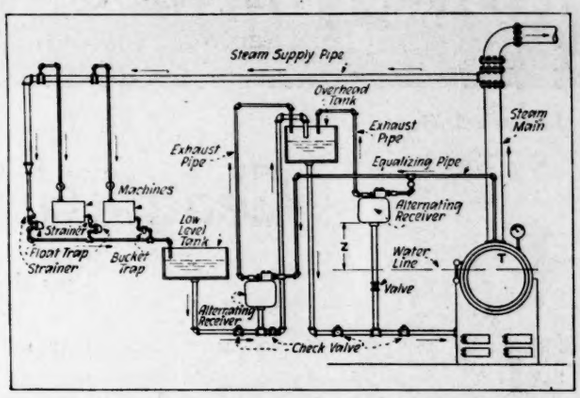


Fig. 4. Two alternating receivers in series, elevating return condensate, and discharging into boiler.

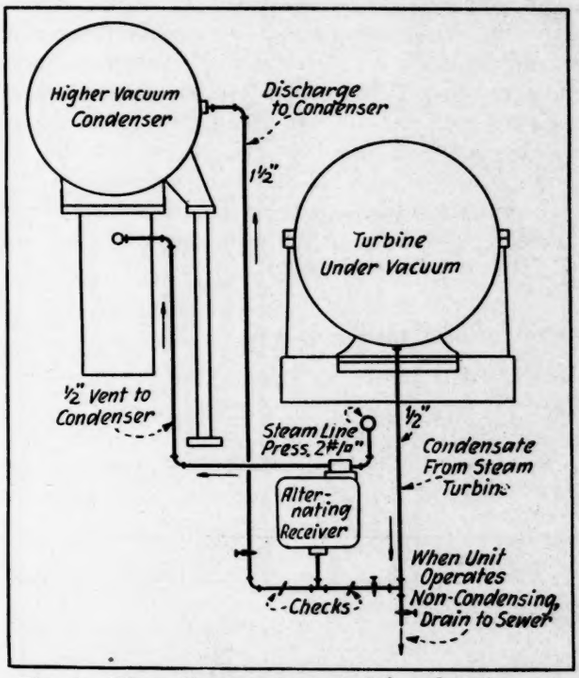


Fig. 5. Alternating receiver used for elevating condensate from turbine to condenser.

a high-pressure boiler where its operation is exactly similar to that in a vapor heating system, but with high steam pressures it is advisable to keep the receiver as high as possible above the boiler water line, two to three feet being a convenient height for such applications.

Fig. 2 illustrates an application for an alternating receiver for elevating water only, while Fig. 3 illustrates a combination of two receivers in series for elevating and discharging water into a boiler.

Even though there may be only a small number of machines or coils connected to a high-pressure steam boiler, it is frequently found desirable to install individual traps at each piece of equipment, and an alternating receiver to return the condensate to the boiler, as illustrated in Fig. 4.

Fig. 5 illustrates an alternating receiver connected to a turbine to drain condensate from the turbine into the condenser which is at a higher level.—*T. Napier Adlam, Chief Engineer, Sarco Company, Inc.*

Centrifugal Exhaust Fans

By JOHN L. ALDEN

IN order to select the fan for an exhaust system it is necessary to know exactly what work the fan is expected to do. Its purpose, of course, is to establish and maintain a prescribed rate of air flow through the various elements of the system. The requirements of the system are expressed in terms of the desired flow rate and the static pressures at the fan inlet and outlet. Until these factors have been established the fan cannot be chosen. Not all manufacturers express fan performance in the same terms. Therefore, in order to fit the fan to the work it is necessary to understand the basic significance of the static pressures at the fan and to interpret the capacity tables in terms of these pressures.

Analysis of System Pressures

In Fig. 84 is shown an exhaust fan connected to an elementary exhaust system. Projected below it are the velocity, static and impact pressures occurring in the various parts of the piping. The velocity pressures are positive in both suction and pressure pipes and are so indicated in diagram 84a. The static pressure, on the other hand, is negative in the inlet pipe and positive in the discharge pipe.

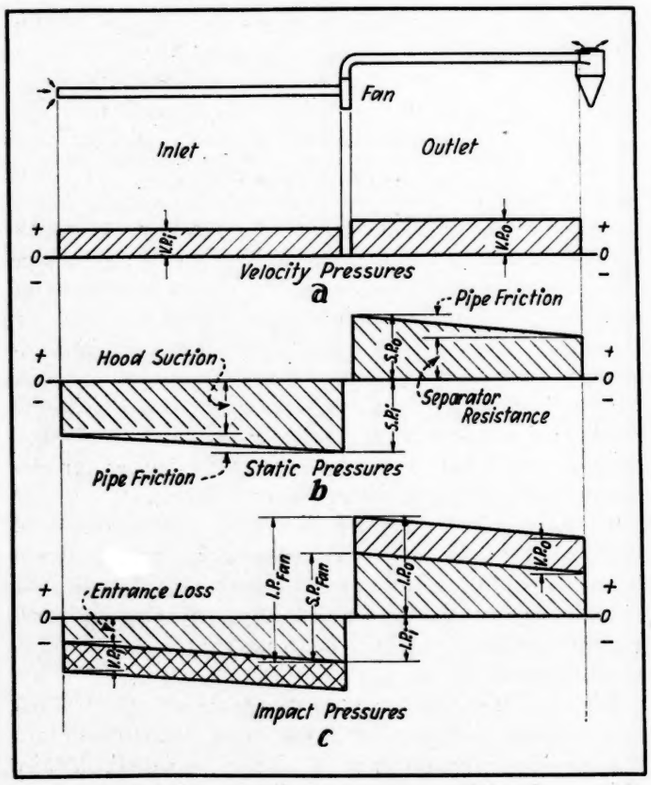


Fig. 84. Pressures in exhaust systems.

The static pressure at the pipe mouth is the negative pressure required to establish inward flow. It provides the energy to overcome the inlet loss and to provide the inlet velocity pressure. The pressure drop between the inlet and the fan represents the friction loss in the pipe and any other resistances present between these points. Similarly, the fan outlet static pressure is made up of the separator back pressure and the discharge pipe friction. Static pressures are plotted in Fig. 84b.

The impact pressure, it will be recalled, is defined as the algebraic sum of the static and velocity pressures occurring simultaneously in a given cross-sectional plane of a pipe. In Fig. 84c these pressures have been combined to form the impact pressures throughout the system. Thus, at the pipe entrance the positive velocity pressure combines with the negative static pressure to produce a negative impact pressure. The total impact pressure which the fan must produce is shown to be the algebraic difference, or, disregarding signs, the sum of the inlet and outlet impact pressures. This is the entire energy output of the fan per cubic foot of air and is the pressure used in determining the power output of the fan and the mechanical efficiency.

Fan Rating Pressures

For purposes of fan rating, the fan static pressure has been defined as the total impact pressure at the fan minus the velocity pressure in the discharge duct. This is indicated in Fig. 84c. Most performance tables use the fan static pressure instead of the impact pressure against which to list volumetric capacity. It is evident that to select a fan from a table prepared in this manner the system pressure requirements must be expressed in the same terms. It must be emphasized that the fan static pressure is not the algebraic difference between the static pressures at the fan inlet and outlet as plotted in Fig. 84b but is this value minus the inlet velocity head. Inspection of Fig. 84c shows that the fan static pressure includes resistance losses only.

Referring again to Fig. 84b and c, it is evident that the algebraic difference of the static pressures at the fan becomes numerically equal to the fan impact pressure when the inlet and outlet velocities are equal. Since this is the common condition existing in most exhaust and conveying systems, the impact pressure at the fan can be determined by the simple measurement of two

static pressures. Moreover, these static pressures are the ones which the designer calculates while designing the piping. It should be noted that the fan static pressure of an operating system cannot be checked by static measurements alone but must include the much more involved measurement of mean velocity. While the fan static pressure is not difficult to compute or to use in selecting a fan, it offers no outstanding advantage over the impact pressure as a basis for performance rating. A few manufacturers publish tables based on impact pressure or combined suction and back pressure which is practically the same. In general, these will be found to be more convenient than the static pressure tables. In any event, the engineer must be alert to the differences in published data when comparing the performance of competitive fans.

Power Consumption

A pressure of 1.0 in. of water is equal to 5.19 lb. per sq. ft. Hence, the work done in moving a cubic foot of air per minute against an impact pressure of 1.0 in. of water is 5.19 ft. lb. per min. Therefore, the power necessary to maintain flow may be expressed in horsepower as

$$Ahp = \frac{5.19\,Qh_i}{33000} = 0.000157\,Qh_i$$

where

Q = volume per min., c.f.m.,
h_i = impact pressure, in. of water.

This is the power output of the fan and would be the power input if the efficiency were 100%. The actual input is the air horsepower divided by the mechanical efficiency. When selecting a fan for a given system, the power consumption is taken from the performance table without going through the calculation of the air horsepower.

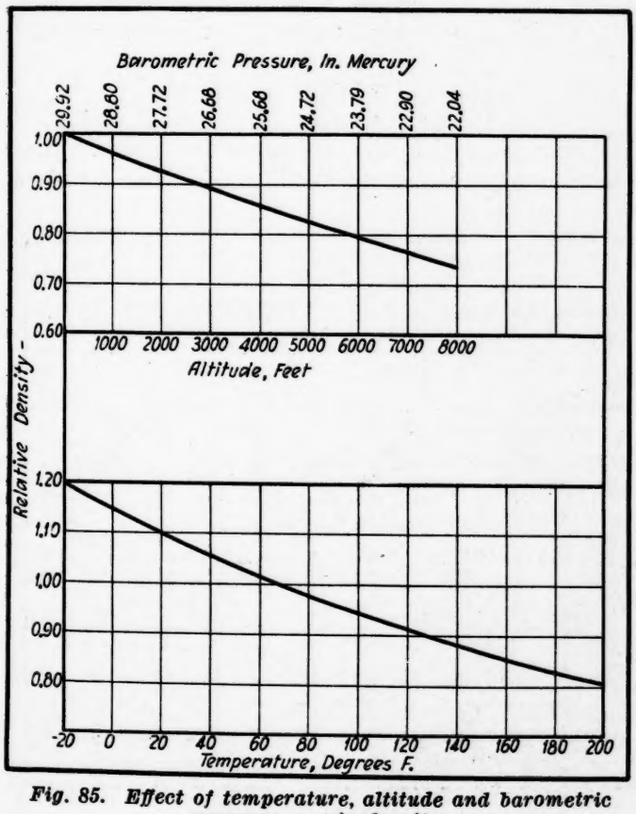


Fig. 85. Effect of temperature, altitude and barometric pressure on air density.

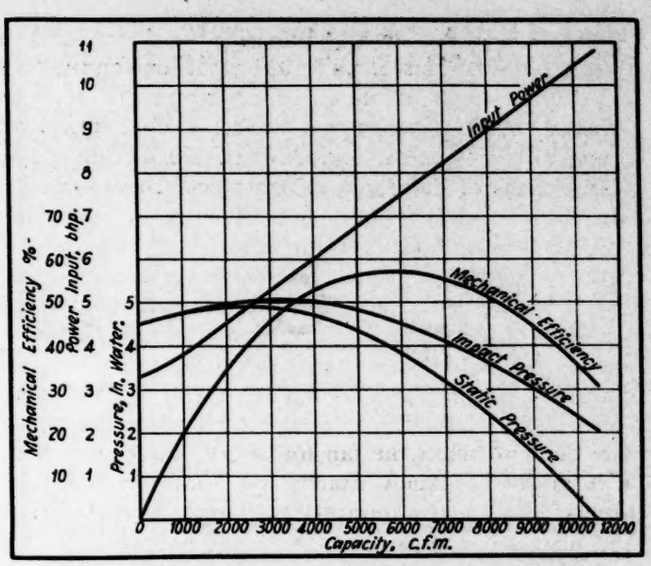


Fig. 86. Performance curves of centrifugal exhauster operating at constant speed.

Effect of Air Density on Power Consumption

A fan operating at constant speed and connected to a given piping system will deliver a constant volume of air regardless of density. Pressure and power vary directly as the density. In Fig. 85 is plotted the influence of temperature, altitude and barometric pressure on the density of air. Roughly, the pressure and power decrease about 4% for each 1000 ft. of altitude above sea level and about 1% for each 5F increase in temperature above that of standard air.

Performance Curves of Centrifugal Exhausters

When tested for rating purposes, exhaust fans are connected to inlet and discharge pipes in which impact and static pressures are measured and the flow rate determined. A symmetrical throttling device in the discharge pipe permits the load to be varied so that several points on the performance curve may be established. A group of curves such as Fig. 86 may be drawn from the test data for a single speed. A family of similar curves covering the entire range of useful speeds may be derived from the original set by the application of certain well-established laws of fan performance. These form the basis for the published performance tables of the manufacturer.

Effect of Speed on Fan Characteristics

At any other speed than the one for which the original curves were plotted the following relations are true when the air density remains constant and the flow is throttled through the identical orifices used in the original test: 1. The capacity is proportional to the speed, 2. the pressure is proportional to the square of the speed, 3. the power is proportional to the cube of the speed, 4. the efficiency is independent of the speed. These laws are illustrated by the performance curves of Fig. 87 which represent the characteristics of a fan operated at three speeds whose ratios are 1.0, 1.1 and 1.2. The capacities at a given discharge opening are also in these ratios. The pressure ratios are 1.0, 1.21 and 1.44 and the power ratios 1.0, 1.33 and 1.73. The efficiency at any opening is constant at all speeds.

Effect of Size on Fan Performance

If a series of fans of uniform proportions and differing only in size is investigated for performance, a single efficiency curve plotted against relative capacity will be found to represent the entire series. Furthermore, the basic shapes of the pressure and power curves will be identical for all sizes although differing in numerical values. The influence of the wheel diameter on the performance, at constant peripheral speed, is as follows: 5. The capacity is proportional to the square of the diameter, 6. the pressure is independent of the diameter, 7. the power is proportional to the square of the diameter, 8. the efficiency is independent of the diameter. These relationships derive from the fact that pressure is a function of peripheral speed; that capacity is a function of wheel volume; and that the power is proportional to the product of capacity and pressure.

Fan Types

The usual fan for dust removal or pneumatic conveying systems is the planing mill exhauster. This is a heavy, rugged fan built to withstand more abuse than the ordinary ventilating fan. Peripheral speeds may reach 15,000 f.p.m. and occasionally as high as 20,000 f.p.m. The fans of heavily loaded systems are subject to bombardment of the conveyed solids. Mats of fibrous material may wedge between wheel and casing. Broken spokes of 5 in. x 5 in. x ½ in. tee section are known and blades 7/16 in. thick have been bent at right angles around the spokes.

Most manufacturers of planing mill fans build both "standard" and "slow speed" models. The wheel of the "standard" fan generally has 6 radial blades. These may be shrouded or open as the character of material to be handled dictates. The several makes differ somewhat in proportions and in minor structural features but, fundamentally, they are very much alike in general characteristics. Consequently, commercial considerations often control the choice of fans of the "standard" type. Price, delivery, local sales representation and similar factors often outweigh any small engineering advantages of one make over another. Since this fan is often sold to meet price competition, there is a tendency to work toward the lower end of the drooping pressure-capacity curve where the efficiency is low. Thus, the engineer may unwittingly select an undersized fan whose operating cost may eat up any saving in purchase price.

The slow speed fan is larger and consequently more costly. Further, its rating tables are more conservative in that they embrace the more efficient portion of the pressure-capacity curve. The saving in power almost invariably justifies the increased first cost of the slow speed type. It is unfortunate that the name "slow speed" has become so firmly attached to this style of fan because the emphasis on this feature attributes to low speed alone undeserved credit for economy. The low speed is a natural consequence of larger wheel diameter and the forward curved blades which some manufacturers employ and has nothing to do with low power consumption. The superior performance of the slow speed fan is due to a multitude of small refinements which are the product of intelligent experimental development, and not to any single bold and startling inventive contribution.

Wheel Types

The planing mill exhauster is a paddle wheel type fan. Although a few fans employ warped blades, by far the larger number are radial or forward curved. The number of blades ranges from 4 to 18 in the principal makes of fan. The simplest form is the cast wool wheel, Fig. 88a. The number of blades is either 4 or 6 and the material usually cast iron or bronze. The maximum safe speed of this type is not much over 5000 f.p.m. Hence, its use is confined to low pressure applications. Wool wheels of the same general form may be built of steel sheets and when so constructed are capable of higher speeds. In either form, the wheel is made as smooth as possible in order that fibrous materials may pass freely.

The long-shavings wheel, Fig. 88b, consists of a hub into which is cast a number of structural spokes and six or eight steel blades riveted to the spokes. These blades are usually radial. The addition of annular

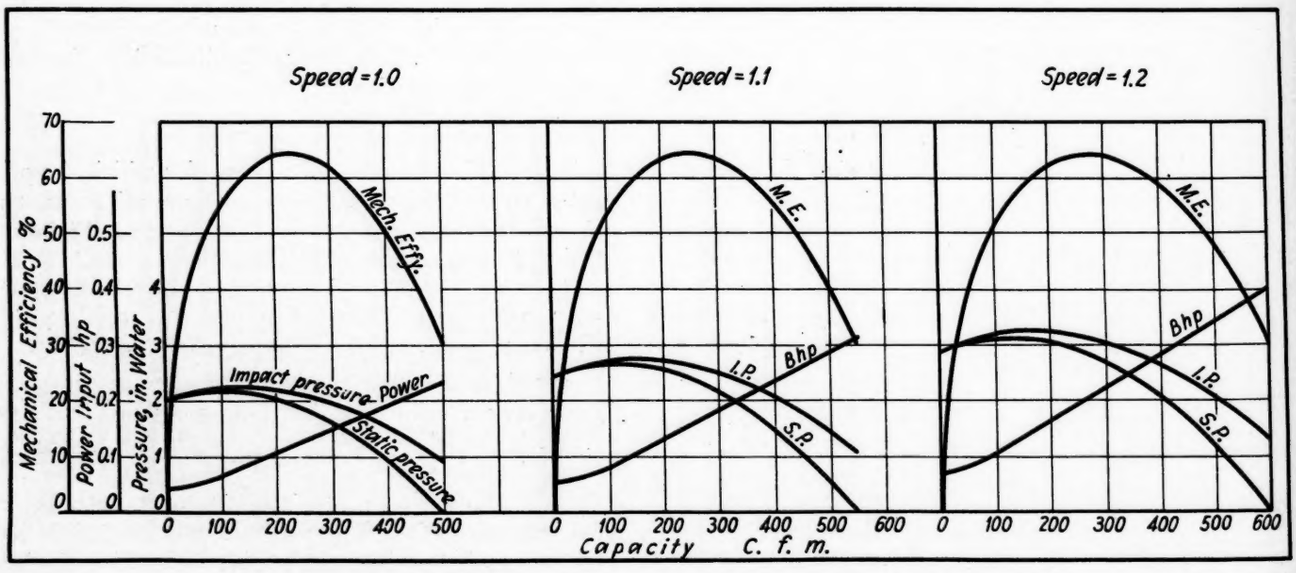


Fig. 87. Effect of speed on performance of centrifugal exhauster.

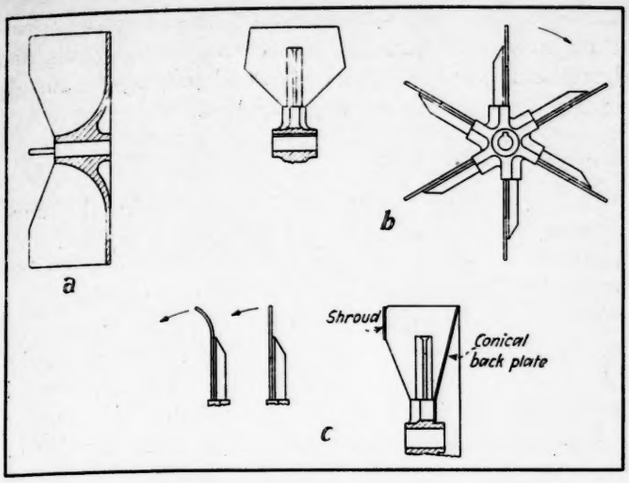


Fig. 88. Exhaust fan wheels.

sheets or side plates convert this wheel into the shrouded or rim-type wheel. Wheels with side plates are somewhat more efficient than open wheels but should not be used on stringy materials such as long fiber, rags or curly shavings.

Slow speed wheels often are equipped with cone back plates as in Fig. 88c. When handling other than stringy materials a shroud may be added to the inlet side of the wheel. Both radial and forward curved blades are shown in the small detail. Although the efficiency may be no greater, the forward curve at the tip of the blade will produce a higher pressure at a given peripheral speed than will the radial blade.

Fan Drives

It is seldom possible to design an exhaust system so that a fan with a direct connected alternating current motor can operate at the optimum pressure and capacity. Small differences in speed produce relatively large changes in pressure and power since these quantities vary with the square and cube of the speed respectively. The small number of common synchronous speeds, 600, 720, 900, 1200 and 1800 r.p.m., makes it difficult to fit the fan and motor to the needs of the system. Moreover, the spread between speeds is so great that none but the most major changes can be made. Thus, to drop back from an 1800 r.p.m. motor to one at 1200 r.p.m. will reduce the volume by 1/3 and the pressure by more than ½.

While the trend in power drives has been away from belts, the belt drive offers to the exhaust fan a degree of flexibility at low cost which is not duplicated by any other type of power transmission. The modern "V" belt permits large speed ratios, short center distances and good efficiency. Small speed changes of the sort necessary for the correction of pressure deficiency or to allow for moderate increases or decreases in the size of the system may be made by a simple and inexpensive pulley change.

Noise and Vibration

Many exhaust systems are objectionably noisy. The characteristic sound is a high-pitched, penetrating hum or whine which may be audible throughout an entire building or for considerable distances outside. No practicable way to reduce this noise substantially is known to us at this time. The offhand solution of the layman is to insulate the fan from the building by means of rubber, cork or composition pads and to connect it to the piping through non-rigid sleeves. While these expedients will render mechanical vibration less objectionable, they are valueless as a means of suppressing noise. Even as an attack on vibration, they treat the symptom rather than the disease. Putting the fan wheel in dynamic balance, or even good static balance, will usually accomplish greater reduction of vibration than will expensive insulating materials.

The primary source of noise in an exhaust system is the fan. To a much lesser extent the vibration of unstayed sheet metal surfaces in the piping system contributes to the general noise level. The rush of air into hoods also is a factor. Nevertheless, the fan is the source of most of the noise and is the point from which it is transmitted, through the air column in the piping, to each hood and to the outside air at the discharge outlet.

While the exact mechanism surrounding the generation of noise in a fan is not entirely clear, there is reason to believe that it is related in some way to the passage of the blades past the cut-off of the casing. Considerable disturbance occurs at this point; pressures change sharply from one side of the cut-off to the other; and the passage of each blade sends forth a compression wave into the air column in both the suction and discharge pipes. Fig. 89 records a series of static pressure measurements taken at various points in a fan case. Pressure tap No. 1 is located at the cut-off and is taken as the reference point for the angular location of the other taps. Pressures at stations 1 to 4 inclusive were

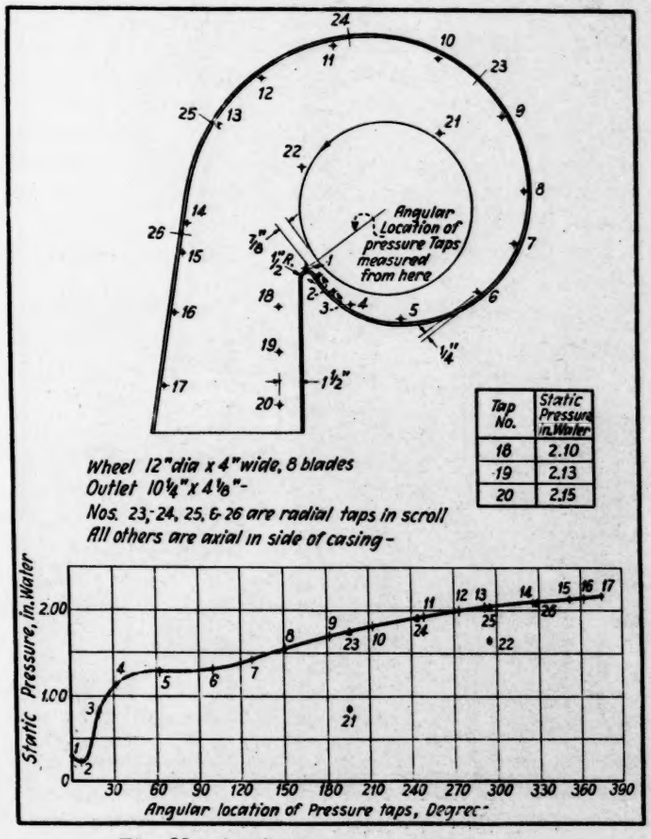

Angular Location of pressure Taps measured from here
3/8"
1/2" R.
1/4"
1½"
Tap No. | Static Pressure in Water
18 | 2.10
19 | 2.13
20 | 2.15
Wheel 12" dia x 4" wide, 8 blades
Outlet 10¼" x 4⅛"-
Nos. 23, 24, 25, & 26 are radial taps in scroll
All others are axial in side of casing -
Static Pressure, in. Water
2.00
1.00
0
30 60 90 120 150 180 210 240 270 300 330 360 390
Angular location of Pressure taps, Degrees

Fig. 89. Static pressures in fan casing.

unstable and difficult to measure with accuracy. The difference between these pressures and the markedly higher ones at stations 15 to 20 inclusive indicates that the zone of the cut-off is a region of special significance.

Further information is derived from a brief study of sound frequency or pitch as related to the number of blades and the wheel speed. The characteristic sound output of the fan consists of a fundamental tone and its harmonics, the latter seldom distinguishable by ear. It is found that the frequency of the fundamental coincides with the number of blades passing the cut-off per second. This has been verified with wheels of various numbers of blades and with radial and both forward and backward curved blades.

The pitch is related to apparent loudness through the characteristic of the human ear which causes a greater sensation of loudness for certain frequencies than for others even though the sound energy remains constant. Thus, for a given energy level, sounds in the neighborhood of 2000 cycles per second† appear to be louder than those at either lower or higher frequencies. Field observation will confirm the conclusion that lower pitched fan noise is less irritating than that produced at higher pitches. Consequently, the combination of rotational speed and number of blades which gives the lowest number of blades per second passing the cut-off is likely to be the least objectionable.

†This is the third octave above middle C on the musical scale.

Dust-Separating Fans

A fan may be so constructed as to combine the functions of an exhauster and a centrifugal separator. All fans of this nature concentrate the solids on a portion of the blade surface by inertia or centrifugal force and discharge the solids and air into separate casings or into compartments of the same casing. Because of the high velocities present, careful design permits good separating efficiency without sacrificing air-handling economy. At least one type appears to be capable of separating particles of 20 micron size with regularity.

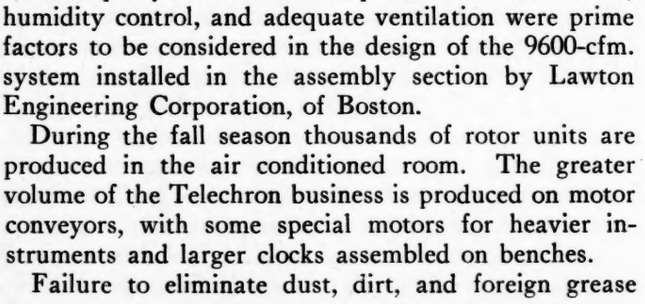
Fans also may be constructed with washing nozzles mounted in the inlet. The effectiveness of air washing fans depends to a considerable extent upon the fineness of the spray droplets, upon the completeness of coverage of the air stream and upon the length of time during which dust and water are jointly in suspension. Accumulation of sludge in the casing and on the fan blades may present a problem.

Air Cleaning Is a Production Factor in Clock Plant

THE air conditioning installation in the plant of the Warren Telechron Company, Ashland, Mass., where thousands of small clock motors are produced weekly, offers an interesting example of benefits which accrue equally to workers and product. Dust removal, humidity control, and adequate ventilation were prime factors to be considered in the design of the 9600-cfm. system installed in the assembly section by Lawton Engineering Corporation, of Boston.

During the fall season thousands of rotor units are produced in the air conditioned room. The greater volume of the Telechron business is produced on motor conveyors, with some special motors for heavier instruments and larger clocks assembled on benches.

Failure to eliminate dust, dirt, and foreign grease from the interiors of the sealed-in motors might result in excess wear and motor failure. Inspection and assembly work is therefore close and difficult, and favorable working conditions are a prime consideration.



Air conditioned motor assembly room of the Warren Telechron Company.

The construction of the building includes a saw-tooth roof with all glass on the side facing north. The assembly room is 75 feet long and 40 feet wide. The system consists of a 25.6-ton compressor, driven by a 20-hp. motor connected to an air conditioner, which provides conditioned air distributed from ceiling ducts. Room volume is 60,000 cubic feet and there is a complete air change every 40 minutes. A mean relative humidity of 50% is maintained. For humidification and air washing, city water is run through the condenser, or condensing unit, and by means of a by-pass is sent into a processing room where large quantities of water are used in a manufacturing process. For this reason there was no need for towers or other water-saving devices.

Cooling is accomplished by the refrigerant at 46F the condenser water temperature being 60F. A dry-type air filter was specified for the installation in order to remove greasy, microscopic dust, dirt, and odors.

In addition to the completely controlled and conditioned flow of air, a slightly higher atmospheric pressure is maintained in the motor assembly room than elsewhere in the factory. When doors are opened to bring in material, an influx of dust and dirt is thereby prevented. Room temperature is held to the proper level by thermostatic control.

An interesting angle of the installation involves a testing rack where 8000 Telechron motors are suspended. Each consumes only two watts of electricity, but this factor increased the heat gain by approximately four and two-thirds tons.

ABSTRACTS of Current Papers, Books and Pamphlets

Welding Handbook

In response to a demand for practical, up-to-date information on welding, the American Welding Society has prepared this 1200-page handbook covering all phases of welding and cutting and allied processes. So as to insure that statements of fact shall be accurate and recommendations authoritative, outstanding authorities have prepared the chapters, which were then submitted to other authorities for review.

The volume covers first, the fundamentals of the various processes; second, the materials used and the testing methods involved; and third, the applications.

The book opens with a section on the economics of welding, which is followed by a chart of welding processes, definitions of terms, welding symbols and instructions for their use. The section on processes covers all types of welding as well as cutting, soldering, brazing, metal spraying, flame hardening and stress relieving. The sections on materials and metallurgy and testing appear next and are followed by the chapters on welding applications.

A few of the subjects covered by the application chapters include boilers, storage tanks, pipe lines, pipe and tanks, piping and fittings, underwater gas cutting, and general maintenance and repair. The last two chapters in the book are entitled "Critical Digests of Welding Literature" and "Testing Terms, Physical Constants and Conversion Tables."

[*"Welding Handbook," 1938 edition. Published by the American Welding Society, 33 W. 39th St., New York. Imitation green leather cover; 6 x 9 in.; 1211 pages; price, $6.00, $6.50 foreign.*]

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Preventing Noise in Air Conditioning Systems

Although the noise caused by a ventilating plant is generally slight, it nevertheless occasionally causes a feeling of annoyance, especially when quiet is essential in the particular room being ventilated. The branch committee of the VDI for the diminishing of noise, in cooperation with the branch committee of the VDI for air conditioning practice, has prepared this paper on noise prevention.

In the first part an endeavor is made to familiarize the air conditioning engineer with the basic data of technical acoustics, particularly with the measurement of noise and the rules for noise prevention. In the second part the publication deals with the possible sources of noise in the ventilating plant and the measures that must be taken in special cases of noise reduction in the drive, the ventilator, the pump, the air ducts, and the places where the air enters into the exhausts from the room being ventilated.

[*"Methods for the Prevention of Noise in Air Conditioning Practice." Published in German by VDI—Verlag GMBH (German Engineering Society), Dorotheenstr. 40, Berlin, N.W. 7, Germany. Paper cover; 8½ x 11 in.; 14 pages; price, 1.50 RM. (Approx. 60 cents.)*]

Central Heating in the Soviet Union

The development of combined heat and power stations having central heating networks is progressing rapidly in the U.S.S.R. The scope of the work was discussed in part of a report presented at the recent World Power Conference in Washington, D. C., by members of the Academy of Science of the Soviet Union.

The section is made up of 32 pages with 26 illustrations and covers the following points on heat and power stations: the concept of heat and power development, types of stations, features, application of high boiler pressures and temperatures, types of turbines, regional stations and the foundation of planned electrical power stations.

The section also presents information on heating networks in the U.S.S.R. Subjects discussed include the heat transmission and its parameters, regulation of heat supply to consumers, mechanical equipment of heating networks, insulation of heating networks, laying heating networks, consumer connections, reliability of heating networks, network layout and current tasks.

[*"Electric Power in the U.S.S.R.," an English translation published by International Publishers Co., 381 4th Ave., New York, N. Y. Clothbound; 5¼ x 8 in.; 495 pages; price, $3.*]

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Air Conditioning

The preparation of a book which covers all of the essential points needed to acquaint the beginner with the important engineering principles applying to air conditioning is not an easy task. The many branches of the industry and the fact that the subject is a highly technical one makes the task doubly difficult.

Probably this book comes nearer to the ideal of presenting really practical information on the whole subject for the beginner than any book which has appeared so far. In most cases the authors do not make the mistake of going into one phase in too great detail but rather limit their discussion to the essential points needed to give a clear understanding. As far as possible they have avoided technical phraseology and complicated mathematical formulas.

A list of the chapters follows: air and its properties; load calculations; duct design and air distribution; registers and grilles; heating and humidification; fans; cooling coils and air washers; fundamentals of refrigeration; compressors, condensers, evaporators and allied equipment; well water cooling—ice cooling and storage systems; evaporative condensers and cooling towers; small store installations—unit coolers; automatic control of air conditioning; air cleaning and purification; codes and ordinances.

[*"Air Conditioning," by Charles A. Fuller and David Snow. Published by The Norman W. Henley Publishing Co., 2 West 45th St., New York, N. Y. Clothbound, 6 x 9 in.; 567 pages; price, $4.*]

Anthracite Manual

For quite some time the gas and oil industries have published manuals dealing with the use of gas or oil for heating. Now the anthracite industry has brought out its manual devoted exclusively to the use of anthracite for domestic heating. The purpose of the book is to serve as a descriptive manual of anthracite as a domestic fuel, including information on the construction, performance, and maintenance of typical equipment and heating systems.

The book is made up of 17 chapters. The first chapter describes how anthracite was formed and discusses its characteristics such as quality, heat content and volume per ton. Chapters two and three point out the importance of selecting the correct size and the proper method of firing.

Since draft is of great importance in the burning of anthracite, three chapters are devoted to draft requirements, forced draft and draft difficulties. Following this is a chapter on maintenance of heating plants. Chapter eight, which deals with the heat requirements of buildings, shows how to calculate the heat loss of a building and how to estimate fuel consumption according to the degree-day method.

The next seven chapters take up the various types of heating systems and auxiliary equipment. A section on servicing of anthracite burning equipment follows this. The last chapter is made up of definitions and terms used in heating work.

[*"Anthracite Industries Manual of Anthracite as a Domestic Fuel." Published by Anthracite Industries Laboratory, Primos, Delaware County, Pa. Cardboard cover; 8½ x 11 in.; 115 pages; price, 50 cents.*]

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BRIEF REVIEWS

LUBRICATION. A discussion on the selection of lubricants for air conditioning and electric refrigeration machinery. Gives information on refinery procedure, effects of water, care in handling lubricating oils, flash point, viscosity, effect of type of compressor, function of oil separators and various methods of lubrication. [*"Selecting the Lubricants for Air Conditioning and Electric Refrigeration Machinery." Published in the July, 1938 issue of "Lubrication," The Texas Co., 135 E. 42nd St., New York, pages 73 to 84.*]

HEAT TRANSFER. A study of the heat transfer rates from condensing steam to air for staggered banks of round, oval or streamline tubes. Streamline tubes gave a much lower air pressure drop through the tube bank but this advantage was offset by lower heat transmission coefficients in all rows except in the first and second. The oval tubes gave lower rates of heat transfer than either of the other two shapes. The data for the round tubes are compared with the various relations that have been proposed to correlate the air film coefficients with the variables influencing the rates of heat transfer. [*"Heat Transfer Coefficients in Staggered Tube Banks," by C. C. Winding. Published in Industrial & Engineering Chemistry, Mills Bldg., Washington, D. C., August, 1938, pages 942 to 947.*]

CONVERSION FORMULAS. A pocket-size book of formulas for the immediate conversion of one unit into another by multiplication alone. Gives in alphabetical order the units of measure, weight, volume, etc., from the various systems of measurements or calculations such as the metric, English, C.G.S. A typical example: British thermal units × 777.8 = foot pounds. [*"Sprinkle's Conversion Formulas," by Leland W. Sprinkle. Published by P. Blakiston's Son & Co., Inc., 1012 Walnut St., Philadelphia, Pa. Flexible imitation leather binding; 4 x 6½ in.; 122 pages; price, $1.25.*]

SOLVENT RECOVERY. An excellent discussion of the recovery of solvents from air by adsorption, absorption and condensation. Includes two charts showing the variation in vapor pressure in 90 different compounds with temperatures ranging from 50 below to 200C. Particular attention is paid to spray recovery systems. [*"Adsorption, Absorption and Condensation in Recovery of Solvents," by Claude A. Bulkeley. Published in the June, 1938 issue of Chemical & Metallurgical Engineering, 330 W. 42nd St., New York, pages 300 to 305.*]

STOKER-FIRED BOILERS. Standard code covering the method of testing stoker-fired steam heating boilers. Code has been officially approved and adopted by the American Society of Heating and Ventilating Engineers and by the Stoker Manufacturers Association. Purpose of the code is to provide a standard method for conducting and reporting tests to determine heat efficiency and performance characteristics. It does not fix the conditions that must be fulfilled for the acceptance or approval of the combination of boiler and stoker. Code recognizes that tests of stokers and boilers may be made under different conditions for different purposes and with complete or limited facilities for conducting the tests. [*"Standard Code for Testing Stoker-Fired Steam-Heating Boilers." Published by Stoker Manufacturers Association, 307 N. Michigan Ave., Chicago, Ill. Paper cover; 9 x 12 in.; 6 pages; single copies available from the Stoker Manufacturers Association. Price for more than one copy is 5 cents.*]

FANS. Third edition of the Standard Test Code for Centrifugal and Axial Fans. The code is sponsored jointly by the American Society of Heating and Ventilating Engineers and the National Association of Fan Manufacturers with cooperation from Committee No. 10 of the Power Test Code Committee of the American Society of Mechanical Engineers. This edition involves clarification of definitions; statements concerning the several methods of testing as applied to various types and arrangements of fans; addition of egg crates or straightening vanes to ducts; a reduction of the allowance for duct friction; and modification of the Pitot tube. [*"Standard Test Code for Centrifugal and Axial Fans." Bulletin No. 103, published by the National Association of Fan Manufacturers, 5-208 General Motors Bldg., Detroit, Mich. Paper cover; 8½ x 11 in. 22 pages; price, 25 cents.*]

PROPERTIES OF SATURATED METHYL CHLORIDE

Temp.	Pressure		Volume		Heat Content		Entropy	
	Lb. per Sq. In.		Cu. Ft. per Lb.		B.t.u. per Lb. Above −40°			
Deg. F	Abs.	Gauge	Liquid	Vapor	Liquid	Total of Vapor	Liquid	Total of Vapor
1	2	3	4	5	6	7	8	9
0	18.80	4.1	0.0161	5.18	11.4	193.6	0.0239	0.4217
2	19.60	4.9	0.0162	4.96	12.2	193.8	0.0251	0.4205
4	20.40	5.8	0.0162	4.75	13.0	194.1	0.0262	0.4193
6	21.20	6.5	0.0162	4.55	13.8	194.3	0.0274	0.4182
8	22.00	7.3	0.0163	4.36	14.5	194.6	0.0286	0.4170
10	22.90	8.2	0.0163	4.18	15.3	194.9	0.0297	0.4160
12	23.80	9.1	0.0163	4.02	16.0	195.2	0.0309	0.4149
14	24.70	10.0	0.0164	3.86	16.7	195.4	0.0320	0.4138
16	25.60	10.9	0.0164	3.70	17.4	195.7	0.0331	0.4127
18	26.60	11.9	0.0164	3.55	18.2	196.0	0.0342	0.4116
20	27.60	12.9	0.0165	3.41	19.0	196.3	0.0353	0.4106
22	28.80	14.1	0.0165	3.28	19.7	196.5	0.0364	0.4095
24	29.90	15.2	0.0165	3.15	20.4	196.7	0.0375	0.4085
26	31.00	16.3	0.0165	3.03	21.2	197.0	0.0386	0.4075
28	32.20	17.5	0.0166	2.92	21.9	197.3	0.0397	0.4065
30	33.50	18.8	0.0166	2.81	22.7	197.6	0.0408	0.4055
32	34.80	20.1	0.0166	2.71	23.4	197.8	0.0419	0.4045
34	36.10	21.4	0.0166	2.61	24.2	198.0	0.0430	0.4035
36	37.40	22.7	0.0166	2.52	24.9	198.2	0.0441	0.4025
38	38.80	24.1	0.0167	2.43	25.7	198.5	0.0452	0.4015
40	40.20	25.5	0.0167	2.34	26.4	198.7	0.0463	0.4005
42	41.70	27.0	0.0168	2.26	27.2	198.9	0.0474	0.3996
44	43.20	28.5	0.0168	2.18	27.9	199.1	0.0485	0.3986
46	44.80	30.1	0.0168	2.10	28.7	199.3	0.0496	0.3976
48	46.40	31.7	0.0169	2.03	29.4	199.5	0.0507	0.3967
50	48.00	33.3	0.0169	1.96	30.2	199.7	0.0518	0.3957
52	49.70	35.0	0.0169	1.89	30.9	199.9	0.0529	0.3948
54	51.40	36.7	0.0170	1.83	31.7	200.1	0.0540	0.3938
56	53.20	38.5	0.0170	1.77	32.5	200.3	0.0551	0.3929
58	55.00	40.3	0.0171	1.71	33.2	200.5	0.0562	0.3919
60	56.80	42.1	0.0171	1.65	34.0	200.7	0.0573	0.3910
62	58.70	44.0	0.0171	1.60	34.8	200.9	0.0584	0.3901
64	60.60	45.9	0.0172	1.54	35.5	201.1	0.0595	0.3891
66	62.50	47.8	0.0172	1.49	36.3	201.3	0.0606	0.3882
68	64.40	49.7	0.0173	1.45	37.1	201.5	0.0617	0.3873
70	66.40	51.7	0.0173	1.40	37.8	201.7	0.0628	0.3863
72	68.40	53.7	0.0174	1.36	38.6	201.9	0.0639	0.3854
74	70.50	55.8	0.0174	1.32	39.4	202.0	0.0650	0.3845
76	72.60	57.9	0.0175	1.28	40.2	202.2	0.0661	0.3836
78	74.70	60.0	0.0175	1.24	40.9	202.4	0.0672	0.3827
80	76.80	62.1	0.0176	1.20	41.7	202.6	0.0683	0.3818
82	79.00	64.3	0.0176	1.17	42.5	202.8	0.0694	0.3809
84	81.20	66.5	0.0177	1.13	43.3	202.9	0.0705	0.3800
86	83.40	68.7	0.0177	1.10	44.1	203.1	0.0716	0.3791
88	85.70	71.0	0.0178	1.07	44.9	203.3	0.0727	0.3782
90	88.00	73.3	0.0178	1.04	45.7	203.4	0.0738	0.3773
92	90.30	75.6	0.0179	1.01	46.5	203.6	0.0749	0.3764
94	92.70	78.0	0.0179	0.98	47.3	203.8	0.0760	0.3755
96	95.10	80.4	0.0180	0.95	48.1	203.9	0.0771	0.3746
98	97.50	82.8	0.0180	0.93	48.9	204.1	0.0782	0.3737
100	100.00	85.3	0.0181	0.90	49.7	204.2	0.0793	0.3728
102	102.50	87.8	0.0181	0.88	50.5	204.4	0.0804	0.3719
104	105.00	90.3	0.0182	0.85	51.3	204.5	0.0815	0.3710
106	107.60	92.9	0.0182	0.83	52.1	204.7	0.0826	0.3701
108	110.20	95.5	0.0183	0.81	52.9	204.8	0.0837	0.3692
110	112.80	98.1	0.0183	0.79	53.7	205.0	0.0848	0.3683
112	115.50	100.8	0.0184	0.77	54.5	205.1	0.0859	0.3674
114	118.20	103.5	0.0184	0.75	55.3	205.2	0.0870	0.3665
116	120.90	106.2	0.0185	0.73	56.1	205.4	0.0881	0.3656
118	123.60	108.9	0.0185	0.71	56.9	205.5	0.0892	0.3647
120	126.40	111.7	0.0186	0.70	57.8	205.6	0.0903	0.3638

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PROPERTIES OF SUPERHEATED METHYL CHLORIDE VAPOR

Saturated Vapor		Superheated Vapor				
		Volume Cu. Ft. per Lb.	Heat Above −40° B.t.u. per Lb.	Entropy B.t.u. per Lb.	Heat Above −40° B.t.u. per Lb.	Entropy B.t.u. per Lb.
Temp.	Press.	Add or Superheat			Add or Superheat	
1	2	3	4	5	6	7
0	18.8	5.31	206.6	0.4851	2.06	0.0044
10	22.9	4.46	206.9	0.4739	2.06	0.0043
20	27.6	3.77	207.1	0.4637	2.07	0.0042
30	33.0	3.22	207.3	0.4544	2.07	0.0041
40	39.4	2.77	207.4	0.4458	2.07	0.0040
50	47.1	2.39	207.5	0.4377	2.07	0.0039
		Add or Superheat			Add or Superheat	
0	18.8	5.37	206.6	0.4850	4.09	0.0087
20	27.6	3.80	207.1	0.4637	4.09	0.0085
40	39.4	2.74	207.4	0.4458	4.09	0.0081
60	54.0	2.01	207.6	0.4306	4.09	0.0078
80	71.5	1.47	207.8	0.4172	4.09	0.0075

Heat Content and Entropy are taken above −40°

METHYL CHLORIDE (CH_3Cl)

Boiling Point, minus 11°F Freezing Point, minus 144°F	Critical Temperature, 289.4°F Critical Pressure, 968.7 lb. per sq. in.

Approximate Specific Heats (Ours Liquid as Unity)

Liquid, from 0.29 to 0.41; Vapor at constant pressure as C_p = to 0.29; and Vapor at constant volume = C_v = 0.18 to 0.24; C_p/C_v = 1.5

Performance on Common Ammonia Power

(Without Liquid Sub-Cooling and Without Superheat in Suction Gas Compression)	Results	
	At 40° Suction	At 5° Suction
	Temperature Range 100°	Temperature Range 100°
Cooling coil (low side) pressure, (lb. abs.)	49.09	32.5
Condenser (high side) pressure, (lb. abs.)	181.5	181.5
Heat in suction vapor, B.t.u. per lb. (column 7)	206.6	206.6
Heat in liquid leaving trap, units, per lb. (column 6 at 85°)	16.4	16.4
Refrigerating effect, (B.t.u. per lb. of refrigerant)	190.2	190.2
Theoretical work of compression, (B.t.u. per lb.)	4.09	4.09
Volume of suction vapor, cu. ft. per lb. (column 3)	3.65	5.31
Theor. lb. of refrigerant per ton, per min.	3.16	3.79
Theor. piston displ. per ton, per min. (cu. ft.)	4.89	7.04
Horsepower per ton	1.0	1.0
Coefficient of performance, cycle	4.7	4.7
Coefficient of performance, actual	3.76	3.76

*Equals difference between two preceding figures.
†By computation, from specific principles.
‡Equals per cent. of theoretical.
§Equals per cent. of two preceding figures.
¶By calculation.

REFRIGERANTS FOR AIR CONDITIONING—METHYL CHLORIDE

The data in the several tables of this sheet present in compact form the commonly desired properties of the refrigerant methyl chloride. The values as tabulated are based on what are believed to be reliable studies. Investigation of the tables printed in various text and reference books showing properties for methyl chloride will be found to be at considerable variance with each other. The exact temperature-pressure relationship of saturated methyl chloride still appears to be open to some question. However, the values as given in this table agree with those commonly published.

Over the range of the tables the specific heats of methyl chloride are variable and the extent of this variation is included in the value given for the specific heats of the liquid. The value of the ratio C_p to C_v is stated as if it were constant at 1.2.

The saturated table extends over the usual range for air conditioning and much commercial refrigeration work. Both gage and absolute pressures are listed for convenience, with the atmospheric pressure considered steady at 14.7 lb. per sq. in. Volumes of both liquid and vapor are given instead of densities, but the density can be found as the reciprocal of the unit volume when this figure is needed. Entropies are included because of their usefulness in analyzing possible performances.

The superheat table is purposely limited to superheats in the region of the temperature and pressure of the suction vapor, and at the temperatures commonly associated with air conditioning and commercial refrigeration work. Superheat properties over the whole range require more space for tabulation than the frequency of their use seems to justify here.

The various properties tabulated at the common rating points for air conditioning and refrigeration purposes are especially valuable when comparing the characteristics of refrigerants. Many of these figures are also applicable for estimating purposes.

The table giving suitable pipe sizes for use with methyl chloride, when the cooling load is known, is believed to be amply safe for most air conditioning and refrigeration purposes since the sizes are based on small velocities and low unit pressure drops in the piping.

PIPE SIZES FOR METHYL CHLORIDE

Nominal Pipe Size In Inches	Vapor Suction Lines		Liquid Lines	
	Cooling Load In B.t.u. per Hour			Lb. of Methyl per 100 Lin. Ft.
	Refrig. (5F)[1]	Air Cond. (40F)[2]		
⅛			7,200	
¼	600	900	48,000	2
⅜	6,000	8,400	84,000	5
½	9,600	12,000	144,000	8
¾	20,000	30,000	300,000	18
1	36,000	54,000	528,000	31
1¼	60,000	84,000	840,000	48
1½	84,000	120,000	1,200,000	69
2	144,000	204,000	2,100,000	121
2½	204,000	300,000	3,360,000	192
3	324,000	468,000		
3½	444,000	636,000		
4	576,000	816,000		
5	816,000	1,200,000		
6	1,296,000	1,872,000		
Max. Velocity f.p.m.	3800	2700	180	
1	2	3	4	5

[1] If suction temp. is under 25F use column headed (5F).
[2] If suction temp. is over 25F use column headed (40F).

NOTE:—Lines ⅛ in. and Less:—Under 25 lin. ft. as tabulated; 26 to 75 lin. ft. use one size larger; 76 to 150 lin. ft. use two sizes larger.
Lines 1 in. to 2 in., Inclusive:—Under 50 lin. ft. as tabulated; 51 to 100 lin. ft. use one size larger; 101 to 200 lin. ft. use two sizes larger.
Lines 2½ in. and Over:—Under 100 lin. ft. as tabulated; 101 to 200 lin. ft. use one size larger; 201 to 300 lin. ft. use two sizes larger.

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• EDITORIALS •

The Rise of the Unit Heater

This month we present a section devoted to the unit heater which has come up from nowhere to challenge old established products and has exerted important effects on heating methods and practices in its comparatively short life span.

For one thing, it focused attention on the possibilities of using rapidly moving air as a means of carrying heat over considerable distances without ducts and at an attractive cost. Most of the cost attractiveness arose from the possibilities of factory fabrication and assembly, which had not been present with central air equipment. This thought has since been widely re-applied until now nearly all items of both heating and cooling equipment are fabricated so far as possible at the factory and applied on the building site with a minimum of field labor. The unit heater was thus the initiator of a trend in method and design.

Another point in connection with unit heaters is that they have been developed steadily. It would not have been especially surprising if, having got started as an innovation in method, the unit heater had settled back into a rut for that is frequently what happens in similar situations. But this has not been the case here, for these heaters have been constantly improved both in appearance and in performance. They now operate more quietly, with greater flexibility of control, and are so vastly improved in appearance that they are finding an ever widening field of application. Certainly no equipment makers in the whole field have been more keen at adopting ideas which improve their product, as witness their use of sound level ratings, multi-speed motors, streamlining of fan blades and heater core passageways, anti-vibration mountings for motors, simplification in erection and, latterly, in the development of standards.

All this has also brought about some notable changes in the sales picture. From their introduction in the early 1920s sales of unit heaters rose slowly but steadily until the depression struck. Then they dropped abruptly but increased over five-fold from 1932 to 1937 when they established new records. The significance of this rise is perhaps best appreciated by a knowledge of the fact that whereas they accounted for a trifling percentage of the dollars spent for heating surfaces in 1925, by 1935 they were accounting for a quarter to one-third of the total. This is a remarkable story and may become even more remarkable as time goes on.

Air Conditioning for Plants

To engineers and contractors who naturally have to keep their thinking directed at the future even though their actions are concerned with the present, there is something very intriguing about the possibilities of applying fully controlled conditions to the growing of plants. Greenhouse heating which aims at maintaining suitable air temperature for growing plants indoors has been dependent almost entirely upon the methods and equipment developed and applied by heating engineers.

Recently a new kind of plant growing has been attracting attention. It consists of setting the roots into a solution of chemicals prepared of the exact constituents necessary to the growth of the plant and without the use of soil. Not only may the chemical composition of the plant food be closely controlled but so also may the temperature of the solution as well. Thus the supply side of the plant's growing process can be pretty closely controlled and the search for ideal conditions can go ahead. Here much has already been done.

However there is another side to the growing process which involves the air in which the plant grows and develops. Fully controlled conditions of temperature, pressure, and chemical composition on this side can also be obtained by existing methods and equipment which have been largely developed and applied by air conditioning engineers for other applications. There is no reason why it could not be adapted to plant growing. The missing connection is more and better information as to what are the best and most practical conditions to be applied to growing plants.

Amazing yields are reported to have been secured when the feeding side of the process is controlled to produce the best possible results. It is quite possible that a study of the other part of the process would show such further improvements in yield that a full measure of control could also be applied to it. At any rate the limits of the control from the air side could be learned.

This is another of those related fields which the development of air conditioning is steadily opening up. From the industrial process application we have already seen the expansion into comfort application, the beginnings of the medical uses are already at hand, just around the corner looms this enormous possibility of adaptation to plant growing. Enough has been accomplished already to make it sure that the traditional greenhouse practices are in for some radical changes.

Outlook is Encouraging

Not for over a year have the signs of real volume in the building industry been so encouraging. Every index, every statistical report, and most writers on the subject agree that the stage is rapidly being set for what may easily prove to be the greatest amount of building construction since the late 1920s. Moreover, it appears that there is to be activity all along the line in all types of buildings instead of its narrow restriction to owner-occupied residences as was the case last year when the situation also looked promising. No group in the building industry has worked more earnestly to improve both its products and its values than have those who are responsible for the heating, ventilating, and air conditioning equipment. No group more deserves the boon which a real return to new building volume would bring. The whole industry is justified in holding high hopes this time for it looks as if the really big activity in new construction will not be long delayed.

WHAT READERS SAY

Day and Night Temperatures

Editor, HEATING & VENTILATING:

Reference is made to an article by Mary O. Soroka on page 50 of the June, 1938 issue of HEATING & VENTILATING.

This article summarizes the times of occurrence of the minimum night time temperature at Washington, D. C. The frequency diagrams show two maxima, one of which is for midnight. We believe that the midnight maximum is a fictitious one due to the current practice of recording the minimum temperature for the calendar day, whereas this study is concerned with a period comprising portions of two calendar days. It is felt that many of your readers may not be aware of this fact and that misunderstanding will result. Although no mention is made of the Weather Bureau as being the source of the data, there is no apparent reason for such a disagreement with our experience, regardless of the source.—*W. R. Gregg, Chief, U. S. Weather Bureau, Washington, D. C.*

Readers who wish further information regarding the article by Miss Soroka which carried the title "Day and Night Temperature Differences in Summer in Washington, D. C." are invited to write to the editor.

KINKS

Advocates Full Use of Relief Valve

Many factories and mills have boiler plants supplying steam for power and heating services. A common layout in these plants is to have a branch connection from the main steam line from the boilers to the engines or turbines. This branch connection supplies heat to the buildings. While many plants utilize the exhaust of the prime movers for the heating system, it is the usual practice to supplement this system with the live steam branch line. Live steam is admitted to the heating system when the prime movers are shut down, or when their exhaust is insufficient for heating demand.

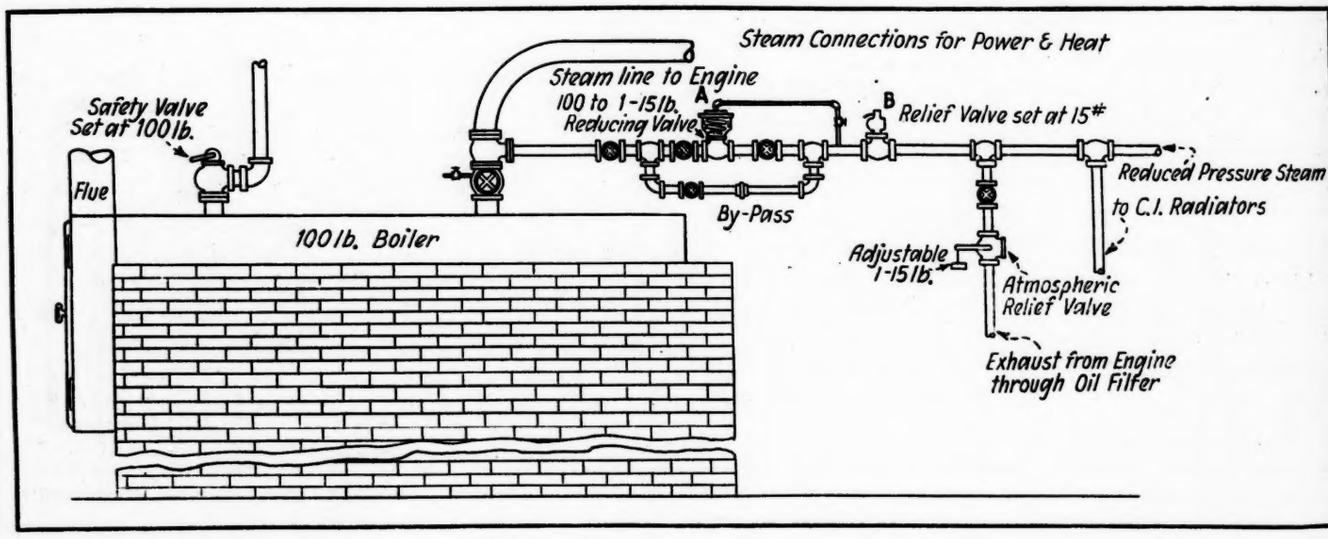
Sometimes the live steam is controlled by a reducing or pressure regulating valve; other times it is controlled manually. In any case there is one often-neglected point that is a vital factor in the safety of the system. This is: How does the maximum possible steam pressure in the heating system compare with the safe working pressure of the heating units? These units may be cast-iron radiators, constructed for a maximum safe steam pressure of 15 lb. per sq. in.

Let us assume that the typical installation, shown in the drawing, includes these cast-iron radiators, and let us assume further that we have a plant where both the reducing valve A, and the relief valve B are omitted. Exhaust steam from the engine is limited in pressure by the atmospheric relief valve, set usually at 2 to 8 lb. At such times when the engine is shut down, live steam is admitted for heating. The only relief for overpressure will be the safety valve on the boiler, set at 100 lb. in the plant shown. It is thus possible for boiler pressure to build up in the heating system and a rupture of a radiator is entirely possible.

For condition number two, we may consider the same general layout, but include the pressure regulating valve A. Installation of the relief valve B is still neglected. Again assuming the engine to be shut down, and its exhaust valve closed, what happens when the pressure regulating valve sticks open, or when its diaphragm ruptures? It should be realized that either of these two regulator defects are more than mere possibilities over a period of years. The instant result will be for the heating system pressure to equalize with full boiler pressure, exactly as if there were no regulator.

When admitting high pressure steam into a low pressure heating system, it is essential for safety to provide both a reducing valve and a properly adjusted relief valve. Too many times this point is neglected. The drawing shows this type of heating system as it should be installed to guard against the possibilities described.
—*Harry M. Spring*

Liberal payment will be made for brief articles which are, in the opinion of the editors, useful and generally applicable kinks relating to drafting room, shop, plant, or field practice in the design, installation, operation, or maintenance of heating, ventilating, or air conditioning equipment. Sketches (in pencil) or photos should be included when necessary.



NEWS OF THE MONTH

Houses Overcrowded, Survey Shows; Crowding Not Confined to Cities

WASHINGTON—The United States Public Health Service has estimated from a recent survey that although one room per person is believed to be a minimum housing standard, 3,000,000 urban families have fewer rooms in their houses than there are persons; that 1,000,000 live in dwelling units having one and one-half times as many persons as rooms, and that 700,000 have twice as many persons as rooms. The findings are based on a survey of 82 cities covering over 700,000 urban households.

On this basis overcrowding was lowest in the west, where 10% of the families surveyed lived in dwellings with more than one person per room, followed by the east and central states, where the percentage was about 15. In the south, where 25% of the persons (both white and colored) were living in quarters having more than one person per room, the figures for the white residents alone showed only 20% living under such conditions.

Contrary to the general belief, overcrowding was found to be a problem of small as well as large cities. For example, in the east 16% of the households in cities of 500,000 population or over had more than one person per room, as compared with 10.1% in cities of under 25,000; in the central states the percentages were 16.5 and 15.5, respectively; in the west 10.6 and 11.5%, respectively; and in the largest cities of the south (100,000 to 500,000 population) 23.1% of the households had more than one person per room as compared with 30.1% in cities of less than 25,000 population.

Matzen Opens Consulting Office

NEW YORK—Harry B. Matzen, formerly vice-president of Carrier Engineering Corporation, has organized a consulting engineering service for air conditioning and refrigeration with offices at 185 Madison Ave., New York.

Mr. Matzen has been associated with air conditioning engineering work with Carrier and the York Ice Machinery Corporation for the past 22 years. From 1925 to 1935, he was manager of Carrier's Cleveland office.

A. C. for Chicago's Orchestra Hall

CHICAGO—The trustees of the Chicago Symphony Orchestra have appropriated $50,000 for air conditioning Orchestra Hall in time for the 48th season, opening October 13. It will serve the entire building which houses and helps support the resident orchestra. The system, which will have a capacity of 180 tons, is being installed by L. H. Prentice Company.

ASME Forms Heat Transfer Group

NEW YORK—The American Society of Mechanical Engineers has established a Heat Transfer Professional Group. The general objective of this group is the improvement in design and operation of all types of heat transfer apparatus. The broad scope of this Group's interests is indicated by the following general division of the field:

(1) Principles of heat transfer and their applications; theory and analysis, experimental work for the elucidating of theory and methods of analysis, as distinguished from performance tests.

(2) Heated and cooled enclosures; heat transfer through walls of furnaces, buildings, insulation, losses from pipe lines, etc.

(3) Unfired equipment; heat exchangers, condensers of all kinds, unfired boilers and evaporators, air conditioning equipment, etc.

(4) Direct-fired fluid heaters and boilers; steam boilers, tube stills, and cracking coils, superheaters, etc.

(5) Direct-fired solid heaters, melters, and smelters; ovens, glass lehrs, cement kilns, open-hearth furnaces, etc.

Correspondence concerning the Group should be addressed to either the chairman, Thos. B. Drew, E. I. du Pont de Nemours & Co., Wilmington, Del., or the secretary, E. D. Grimison, The Babcock & Wilcox Co., 19 Rector St., New York.

ASHVE Elects 12 As Life Members

NEW YORK—The council of the ASHVE has announced the election to life membership in the society of 12 men of long standing in its affairs who are prominently identified with air conditioning, heating and ventilating. They are:

George W. Barr, district manager, Aerofin Corp., Philadelphia; William W. Cox, president-manager, Heating Service Co., Seattle; John B. Feehan, president-treasurer, John B. Feehan, Inc., Lynn, Mass.; James J. Finan, supervising engineer, Board of Education, Chicago; Charles V. Haynes, vice-president, Hoffman Specialty Co., New York; Edgar Herring, chairman, J. Jeffreys & Co., Ltd., London; John J. Nesbitt, secretary-treasurer, John J. Nesbitt, Inc., Philadelphia; James K. Peacock, assistant secretary, Hoffman Specialty Co., New York; Kunisuke Sekido, consulting engineer, Tokyo, Japan; Nelson S. Thompson, supervising engineer, U. S. Treasury Dept., Washington, D. C.; E. Arnold Vivarttas, consulting engineer, West New Brighton, S. I., New York; Allen W. Williams, managing director, National Warm Air Heating & Air Conditioning Association, Columbus, Ohio.

Universities to Study Insulation, Air Friction and Distribution

NEW YORK—The University of Toronto has become the first Canadian institution of higher learning to associate itself with ASHVE research activity. Under a cooperative agreement this university will make a special study of the physical properties of insulating materials, giving special consideration to the macro and micro structure of the cellular arrangement of the material. Cooperative research agreements have also been entered into between the ASHVE and the University of Wisconsin and the Case School of Applied Science, and one is pending with the University of Illinois to expand the study of air distribution and air friction as related to the design and performance of air conditioning equipment.

The air distribution program will cover three points: (1) Tests of the effect of air distribution as the air in circulation approaches the air outlet, including tests with variable shaped openings. This research is being undertaken at Wisconsin. (2) Tests at Illinois in a specially constructed laboratory whose walls, ceilings and floors may be heated or cooled, to determine the most efficient location of air outlets. (3) Study and comparison at Case of instruments used for air velocity measurement and the behavior of air discharge from grilles into large unconfined spaces. In addition to this research, the society laboratory in Pittsburgh announced virtual completion of air friction studies on straight ducts and the extension of its investigation relating to air friction in duct fittings including elbows of various types.

Cooled Cows Give More Milk

SALEM, MASS.—A method of cooling a cow barn and increasing milk production by using dry ice has been successfully tried out by A. A. Colley, manager of H. P. Hood & Sons' Cherry Hill Farm in North Beverly, near here. He ordered a ton of dry ice and several large electric fans, with the ice installed about the barn so that the 178 cows quartered there could feel the benefit of the air thus cooled, without being exposed to a straight draft. Inside of an hour the barn's temperature had dropped 23F on a very hot day. The next day the cows gave 84 extra quarts of milk. Mr. Colley is now trying to figure out how he may air condition the barn so that the cows will have an even temperature best suited to their health and milk-giving qualities, and whether the probable increased milk production would make such a system pay.

Boston Hospital to be Conditioned

BOSTON—A new section of George Robert White House at the Massachusetts General Hospital here is now under construction. It will have one of the most complete systems of air treatment of any hospital in the country. There are to be 12 operating suites, which will be completely air conditioned. Coolidge, Shepley, Bulfinch & Abbott, Boston architects, planned the building, and the air conditioning system was designed by the office of Hollis French, consulting engineer.

One of the features of the air conditioning system is the double filtration. The air first passes through automatic, self-cleaning filters, then through a water spray to be thoroughly washed, and finally through renewable filters on each outlet. When patients having contagious diseases are in the rooms, filters will also be placed on the exhaust air grilles, thus insuring the removal of air-borne impurities and reducing the possibility of any disease bacteria lodging in the ducts.

Similar precautions have been taken to insure proper atmospheric conditions. It having been determined that a temperature of 80F with a relative humidity of 55% was most desirable, these conditions will be automatically maintained, winter and summer, by accurate controls.

For economy, while preparing the rooms for operations, automatic bypass dampers will be installed to allow recirculaton of air. When the operating suites are in use, however, the entire air supply will be drawn from outdoors, with 12 complete changes of fresh air every hour.

Conditioning will be done in five spray-washer type central station units, the water temperature being regulated by two refrigerating compressors of 50 tons cooling capacity each, during summer. Coils in the units, supplied with steam from the hospital's nearby central heating plant, will heat the air in winter.

A separate fan on each unit will draw the air through the sprays and distribute it through ducts to outlets directly over the lighting fixtures in each room. Evaporative condensers will be used to save water. All pipes are to be equipped with vibration eliminators and compressors, fans and condensers will be mounted on springs. Each of the five central units will have a remote control switch at its respective nurse's station.

15th H. and V. Congress Scheduled

NEW YORK—It is announced that the 15th Congress for Heating and Ventilating is to be held in Berlin from September 21-24. The announced program includes 14 papers by well known German engineers and investigators.

Low Death Rate at A.C. Hospital Perhaps Due to Low Humidity

BOSTON—Dr. Albert G. Young, medical director of the Corey Hill Hospital, which is now in its second year of air conditioning, reports that of 743 operations performed at the hospital during the past year, only one case of post-operative pneumonia developed and that showed quick recovery. With characteristic medical conservatism, Dr. Young raises the question whether the very low humidity from air conditioning might have been a factor in the unusually low death rate in the series of operations. Of the 743 operations only nine deaths resulted, and six of these were cancer cases, diagnosed as hopeless before the operations. "The unusually small number of deaths and the occurrence of but one case of post-operative pneumonia would seem to indicate that air conditioning may have been a beneficial factor," says Dr. Young.

Formerly, according to a survey made by the Massachusetts General Hospital authorities, lung trouble, or "post-operative pneumonia," was expected in 6 to 7% of operations. Humidity at Corey Hill is kept at 30%, with a margin of not more than 2% each way, except during the operation in the amphitheater when humidity is raised to 55%, to give protection against possible explosions of anaesthetic gases.

Alabama Utility Studies A.C. Market

BIRMINGHAM, ALA.—The market for commercial air conditioning in Birmingham, as perhaps typical of that in other cities, is barely scratched according to a survey recently made by the Birmingham Electric Company. The survey does not include the residential field.

The survey of every business establishment in the city showed the present connected load as 4,007 and the anticipated additional load in the next three to five years as 11,689 hp., representing an investment in equipment of an additional $3,000,000.

The only fields in which there is anything like saturation is in department stores, variety stores and theaters. Nine out of 12, or 75%, department and five and ten cent stores have air conditioning and the same percentage applies to the theaters. Funeral parlors and hotels come next with a 45% saturation.

The great field for air conditioning in the future seems to be in the small shops, restaurants, grocery stores, and the like. Saturation in barber and beauty shops is only 11%, drug stores 8% and in delicatessens, bakeries and groceries, 6%.

The survey, put out for the benefit of dealers, declared that practically every business establishment not now air conditioned is a prospect and estimated that sales during the 12-month period would be $300,000 or about the same as for 1937.

Details of the survey are shown in the table.

Contractors Hold All-Day Outing

NEW YORK — The Association of Plumbing & Heating Contractors of Greater New York, Inc., held its first annual outing at Glenwood Landing, Long Island, August 25. About 125 attended the affair which began at 10 a. m.

On the program were numerous athletic and semi-athletic events, softball games, swimming, and other entertainment. The outing closed with a shore dinner which was enlivened by the entertainment of Eddie Clark, Broadway entertainer.

ESTIMATED POTENTIAL AIR CONDITIONING MARKET IN BIRMINGHAM, ALA.

Compiled by Birmingham Electric Company

Classification	No. Present Installations	Possible Install.	% Present Saturation	Hp. Now Installed	Hp. Possible	Aver. Hp. per Install.
Barber shops and beauty shops	4	36	11	21	186	5.2
Apparel shops	22	103	21	142	665	6.5
Delicatessens, bakeries and grocery	2	33	6	20	330	10
Department, five and ten stores	9	12	75	2038	2720	226
Drug stores	2	25	8	33	406	16.3
Funeral parlors	4	9	45	62	138	15.5
Hotels—public rooms	—	—	45	183	400	—
Hotels—guest rooms	—	—	2	40	2000	—
Theaters	11	17	75	875	1175	80
Restaurants	8	27	30	270	915	34
Display rooms	2	22	9	32	350	16
Offices	—	—	9	151	1600	.5
Apartments	—	5	8	39	500	—
Misc.—public buildings	4	12	33	101	300	25.3
TOTAL	68	301	—	4007	11,685	—

50 A.C. Restaurants in One Chain

BOSTON—Air conditioning of its restaurants as a standard policy has been adopted by the Waldorf System, Inc., and the installation of systems in all its outlets not yet so equipped will go forward under the supervision of the company's engineers and W. M. Hopwood, who has had years of experience in the management and maintenance of Waldorf restaurants.

The company's first air conditioning system was installed in a Boston unit in 1933 and, recognizing from the results here that air conditioning would become an important factor in restaurant service, James J. Curry, president of the Waldorf system, established a definite policy for all future installations, by which air conditioning was placed on a strictly business basis, with a definite method of measuring results and amortizing costs of equipment over a ten-year period for each installation, with operating expenses to be added. Each system was to be credited with 50% of the increased business obtained during June, July, and August. After deducting restaurant overhead, the management was able to determine the profit on its investment in each unit. The company now has over $200,000 invested in air conditioning equipment in 43 restaurants, with 7 more under way.

Conditioning for Stored Apples

ASHLAND, MASS.—George Greene of this town finds that with air conditioning for his apple storage rooms, he can market the fruit for from fifty cents to a dollar per bushel more than from common storage in spring, when apples are scarce.

In a completely insulated room, he now stores 10,000 bushels of apples from September to March of each year in excellent condition by maintaining a uniform climate of 32 to 34F and 85 to 90% relative humidity. These conditions are maintained by an automatically controlled air conditioning system. Under these conditions constant handling is eliminated, spoilage reduced to a minimum and the crop is marketable at good prices long after the market supply has been depleted. Mr. Greene is now building a 6000-box addition to his storage space for the coming fall.

Chicago Reports 143 A.C. Jobs

CHICAGO—According to reports of the Commonwealth Edison Company, 143 air conditioning installations were added to the company's lines during July. These totalled 457¾ tons. Of the 143 installations, 47 were central plants having a combined capacity of 382½ tons. The largest installation reported for the month was a 50-ton job in the Spencer Recreation Building on N. Cicero Ave.

Brooklyn Poly Revises Courses

BROOKLYN, N. Y.—Polytechnic Institute of Brooklyn has revised its air conditioning courses which have been offered for several years. Two courses are now available. The first, Air Conditioning, covers the fields of winter and summer conditioning in a practical manner and is open to students who have not had previous college training and are desirous of learning the basic elements involved in the design, selection and operation of equipment.

The second course, Air Conditioning Engineering, is intended for those who have had instruction in thermodynamics and other advanced technical fundamentals. The course covers the same field of study but deals comprehensively with theory and practice. Both courses extend throughout the year and include laboratory studies using the Institute's newly installed test equipment and other laboratory facilities. The lectures are by John James, ASHVE technical secretary, while laboratory work is under the direction of Prof. J. A. Lambertine of the Institute faculty.

Philadelphia Adds 114 A. C. Jobs

PHILADELPHIA — The Philadelphia Electric Company reports that 114 air conditoning installations were added to its lines during the first six months of 1938. These had a total connected horsepower of 5529.3.

Among the large installations was one in a printing and lithographing establishment, 129 hp., 31 theater installations totaling 2212.5 hp., and 2 department stores totaling 1269 hp.

The utility now has a total air conditioning load on its lines of 14,186 hp.

Boston A.C. Men to Meet at Resort

BOSTON—The annual outing of the local Air Conditioning Bureau will be held at the New Ocean House, Swampscott, September 23. This annual outing of the Bureau has come to be such an event that it has attracted an increasing attendance each time it is held. This year an especially interesting program is promised by Daniel Ricker, secretary. Other officers of the Bureau are Henry R. Sewell, president, Rudolph Sommers, vice-president, and E. D. Johnson, treasurer.

New Publicity Head for School

LOS ANGELES—William Sanford has been appointed national director of public relations and placement service by the Thermo Air Conditioning Institute. Mr. Sanford, who has been connected with the local headquarters of the Institute, will spend most of his time in Chicago and New York.

Frank Heads New ASHVE Committee

NEW YORK—A committee on public relations has been named by E. Holt Gurney, president of the ASHVE, to clarify the public conception of air conditioning and define the service which users can expect from various types of systems. The committee will develop an educational program designed to enlighten users of air conditioning systems, hoping thus to combat misleading claims by unscrupulous elements.

J. M. Frank, president, Ilg Electric Ventilating Co., is chairman of the new committee which includes Willis H. Carrier, chairman of the board, Carrier Corp.; Charles K. Foster, vice-president, American Radiator Co.; L. C. Harvey, vice-president, Bryant Heater Co.; E. W. Lloyd, vice-president, Commonwealth Edison Co., Chicago; J. O. Ross, president, Auditorium Conditioning Corp.; H. M. Hart, president, L. H. Prentice Co., Chicago, and E. D. Harrington, research engineer, General Electric Co.

Aims to Dissipate Fog by Use of A.C

ALAMEDA, CALIF.—A Colorado inventor has proposed to the city council a project for air conditioning the entire city by installing underground pipes in the middle of the principal streets, the United Press reports.

He promises not only to keep the city warm in winter and cool in summer, but to dissipate the fogs and other inconveniences.

Neiler, Rich Now 44 Years Old

CHICAGO—Neiler, Rich & Company, consulting engineers, celebrated their 44th anniversary recently. Samuel G. Neiler, operating head of the organization, is now a life member in the ASHVE, ASME, and AIEE.

Use of Oil Up in Massachusetts

BOSTON—The Division on the Necessaries of Life, Department of Labor and Industries of The Commonwealth of Massachusetts reports that during the heating season of 1937-38 consumption of anthracite remained about the same as for the previous year while oil consumption increased and decreases were noted for coke, bituminous coal and gas. The following table shows the comparative figures for the last two heating seasons on the fuel consumption for home heating in Massachusetts:

FUEL	1936-1937	1937-1938
Anthracite (Domestic) tons...	2,483,000	2,483,000
Anthracite (Buckwheat) tons..	178,000	192,000
Coke, tons	1,027,000	919,000
Bituminous coal, tons.....	1,100,000	823,000
Briquets, tons	56,000	46,000
Other solid mf'd. fuels, tons...	5,000	12,000
Oil, gal.	750,000,000	795,000,000
Gas (estd.), cu. ft.	3,301,593,000	3,269,266,000

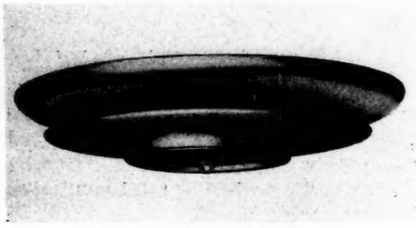
NEW EQUIPMENT

Herman Nelson Unit Heater

NAME—Herman Nelson propeller-fan type hiJet heater.
PURPOSE—For steam or hot water heating of all types of industrial and commercial buildings.
FEATURES—Fan of new streamlined design with large face area, combines quieter, smoother operation with increased efficiency. Heating element is designed with loops to absorb difference in expansion and contraction between individual tubes. Entire tube and loop is fabricated of red brass with no connecting joint. Tubes project from side of supply header, above center line, to assure proper distribution of steam. A patented stay tube maintains proper relationship between headers. Motor, for single, two or three speed operation, and fan assembly are mounted on steel arms designed to absorb and dissipate torsional vibration preventing transmission of vibration to cabinet. Louvers are adjustable and curved to direct heat downward. Grille or discharge nozzle may be used in place of louvers. Cabinet, of attractive, rounded design, is built of heavy gage sheet steel and finished in steel grey "Morocco." The hanger and steam connection are located near the center of gravity for ease of installation.
SIZES AND CAPACITIES—18 sizes for use with steam or hot water. Air capacities ranging from 275 c.f.m. to 5060 c.f.m.
MADE BY—*The Herman Nelson Corporation, Moline, Ill.* *1*

Barber-Colman Ceiling Outlet

NAME—Venturi-Flo.
PURPOSE—A ceiling outlet designed to properly mix conditioned air and room air and distribute the mixture.
FEATURES—This outlet, which is constructed entirely of stamped or spun steel, is made up of a ceiling plate assembly and a diffuser assembly. Supply air enters the unit from a duct and flows outward through a venturi opening. The supply air in passing through the venturi opening draws some of the room air into the opening and a mixing action occurs. The mixture is then distributed sidewise in all directions. The manufacturer states that in performance the Venturi-Flo has a lower pressure drop and noise level than usual outlets and that the air distribution is uniform and free from drafts. The size of the veturi opening may be adjusted to provide for different capacities and throws.
SIZES AND CAPACITIES—Made in 32 in. size at present; two other sizes, one larger and one smaller, available in the near future. Capacities range from 275 c.f.m., with a 4-ft. throw and 1-in. venturi opening, to 2300 c.f.m., with a 20-ft. throw and 3-in. venturi opening when installed in a room with an 8 ft. 6 in. ceiling. Increased capacities possible with greater ceiling heights.
MADE BY—*Barber-Colman Co., Rockford, Ill.* *2*

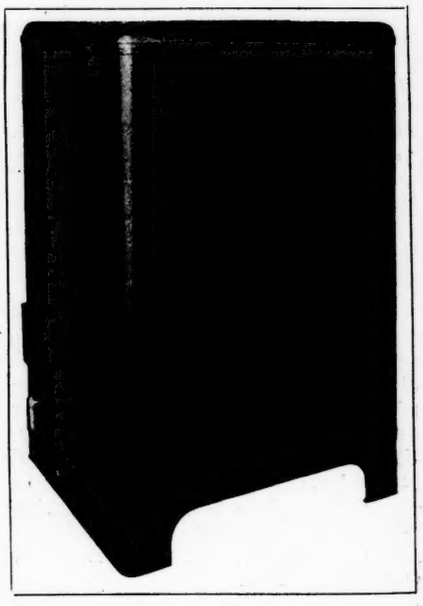


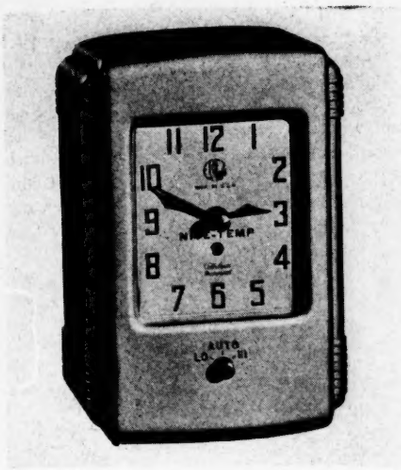
Friez Automatic Gas Pilot

NAME—Friez automatic gas pilot.
PURPOSE—A combination pilot flame and control which turns off the gas if the pilot flame is extinguished.
FEATURES—Automatic gas pilot contains only one moving part with no bearing, pivots or other points requiring service. The pilot burner is of the Bunsen type and is provided with a long, protective flame guide of high temperature resisting chromium nickel alloy steel. It is said that the flame guide helps the flame to resist the blowing or sucking out action of various draft conditions. The thermal element of the automatic pilot consists of two strips of the same metal attached together at the end with a thin sheet of insulation between the two strips. The flame from the pilot impinges on one of these sheets while the other is insulated from the flame. The differential in temperature causes a slight curvature of the element, which is transmitted through a magnification means to the electrical contact which is clear of heat. If the pilot burner goes out, the automatic switch will break the circuit in about 30 seconds when the main burner is not in operation; and when the main burner is in operation, from 10 to 15 seconds. This automatically shuts off the electric gas valve supplying gas to the unit.
TYPES AVAILABLE—Available in two types, one with a drop-on type main body for vertical mounting and the other with a threaded orifice fitting screwed into the main body for horizontal mounting.
MADE BY—*Julien P. Friez & Sons, Baltimore, Md.* *3*

Trane Gas Unit Heaters

NAME—Trane gas unit heaters.
PURPOSE—For supplying warm air to a room using gas as a fuel.
FEATURES—These unit heaters are available in both the suspended types and floor types. The operation is automatic once the pilot has been turned on. The thermostat which controls the operation may be installed in any remote position. A Trane coordinated safety control which is a combination gas pressure regulator, automatic main gas valve, safety pilot control, high temperature cut-off, and reset mechanism is provided. The heat exchanger and generator are made of non-ferrous metal, die formed. All controls and other mechanical parts are completely enclosed in an attractive cabinet made of high-grade furniture steel finished in tapestry crackle brown enamel. An air circulation control switch shuts the gas valve if the fan stops operating.
SIZES AND CAPACITIES—Made in either suspended type or floor type. Three models of each with capacities from 45,000 to 85,000 B.t.u. per hr. input.
LITERATURE AVAILABLE—Bulletin 321.
MADE BY—*The Trane Co., La Crosse, Wis.* *4*



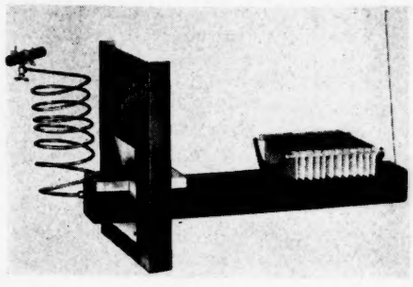


Friez Clock Switch

NAME—Friez "Nite-Temp" clock switches.
PURPOSE—A synchronous, self-starting electric clock switch especially suited for day-night temperature control.
FEATURES—This instrument when applied to thermostats and effective temperature control instruments will give an automatic night-time temperature set-back. The clock switch may be located either with the thermostat or other control instrument or in some other remote location, wherever the clock could be used as a time-keeper. Clock motors operate on 20 volts from small transformers supplied with the clocks, which in turn are supplied with 110 or 220 volts.
MADE BY—*Julien P. Friez & Sons, Baltimore, Md.* 5

Air Conditioning Humidifier

NAME AND MODEL NUMBER—Type C humidifier.
PURPOSE—For adding moisture to air in such equipment as warm air plenum chambers, ducts and concealed radiator flues or cabinets.
FEATURES—Consists of a welded steel evaporating pan and an automatic water-tender for carrying the water from the pipe to the pan and for accurately controlling the water level. The manufacturer states that because of its small width and depth—4 in. wide and 3 in. deep—the pan can be installed in very limited spaces. Where it is necessary to increase the capacity, this can be done by heating either the air or water by means of steam, water, gas or exhaust pipe from any combustion chamber. The capacity can be still further increased by absorbent evaporator plates, suspended from racks, which hold a dozen plates each. Where there is a need for increased capacity, but insufficient width for the standard evaporator plates, highly absorbent Water-Wix are available.
SIZES AND CAPACITIES—4 in. wide, 3 in. deep, in lengths of 20, 30 or 40 in.; special lengths to order.
MADE BY—*The Air Conditioning Supp y Co., Cleveland, Ohio*.....6

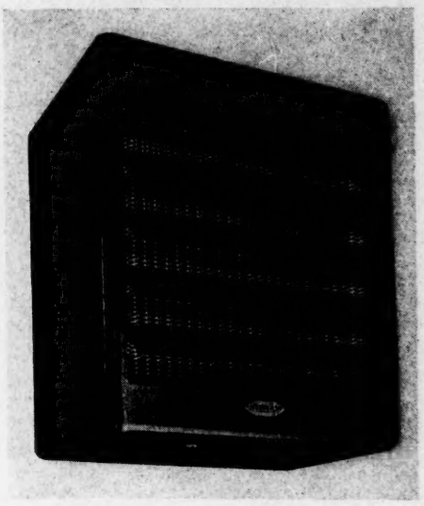


Sterling Deep Well Pump

NAME—Sterling small capacity deep well turbine pump.
PURPOSE—For pumping from 10 to 60 g.p.m. water from wells up to 300 ft. head.
FEATURES—This pump is designed for application where from 10 to 60 gal. of water is required per minute and where a well of at least 6 in. inside diameter is available. Pump is designed for 2, 3, or 5 hp. motors, single and three-phase, to operate at a speed of 1760 r.p.m. on 60 cycle current. It may be set to a depth of 200 ft. in the well. The pump will deliver varying capacities depending on the head required. For example, 10 g.p.m. can be delivered from 140 to 300 ft. head, while 60 g.p.m. can be delivered from 90 to 195 ft. head.
LITERATURE AVAILABLE—Bulletin No. 48.
MADE BY—*Sterling Pump Corp., South Bend, Ind.* 7

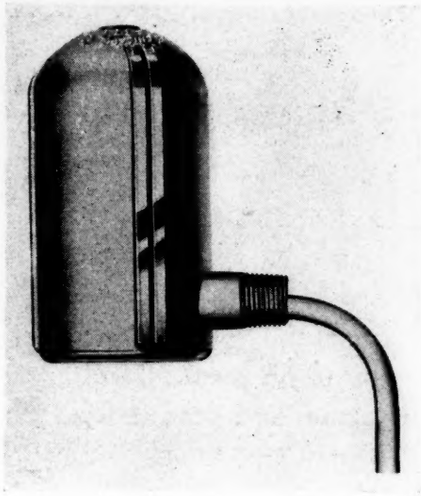
Fedders Unit Heaters

NAME AND MODEL NUMBER—Fedders unit heaters, Series 4.
PURPOSE—For heating air using steam.
FEATURES—Included in the improvements of this line of unit heaters are new cabinets, new heating elements with double headers, new manifolds and improved full floating mountings for eliminating expansion stresses and maintaining alignment between the element and cabinet. Other features include streamline tubes, individual convoluted fins which are designed to prevent expansion stresses between the tubes and fins and between bonding points, as well as between adjacent tubes. Fin surface is designed to reduce dirt and lint accumulation. Quiet operation is claimed because of the mono-piece cabinet rigidity which is combined with a sound-deadening fabric between the casing and fan shroud. Motors are mounted in rubber to isolate vibration. Each motor is said to be tested in a soundproof room for absence of hum and quietness of operation. Motors for all current characteristics are available, including motors for operation under Underwriters' Class 1, Group D explosive conditions. All motors are fully enclosed.
SIZES AND CAPACITIES—25 sizes ranging in capacities from 75 to 1200 sq. ft. equivalent radiator surface.
MADE BY—*Fedders Mfg. Co., Buffalo, N. Y.* 8



Econ-O-Col Stokers

NAME—Econ-O-Col bin-feed stokers.
PURPOSE—For automatic firing of coal direct from bins to fire chamber.
FEATURES—These stokers are available in two models, the transfer model and the pull-thru model. The pull-thru model has the motor and fan mounted on the opposite side of the boiler from the feed screw, while the transfer model has the power supply and fan mounted on the same side as the feed screw and requires only one entrance to the ashpit. Both of these stokers incorporate a double capacity fan in a sound-absorbing, cast-iron housing. A patented air volume control is used to automatically regulate the supply of air through the fire-bed for the most efficient combustion. The retort has special air openings designed to keep the coal out of the air chamber and to properly distribute the air. The transmission is of the automatic type and all parts operate in bath of oil. Both models may be installed with feed screws either above or below the floor line of the basement. Illustration shows the transfer model.
CAPACITIES—Both models furnished in capacities of 35 and 55 lb. per hr.
MADE BY—*Econ-O-Col Stoker Division of Cotta Transmission Corp., Rockford, Ill.* 9



Marsh Automatic Air Valve

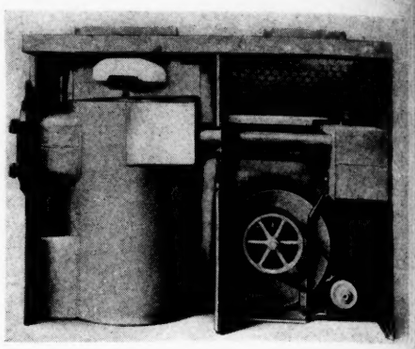
NAME AND MODEL NUMBER—Marsh adjustable venting automatic air valve, No. 73.
PURPOSE—For controlling the rate of air venting from steam radiators and for preventing the escape of steam.
FEATURES—Valve has a double shell construction. Air is vented into the compartment formed by this shell where it expands and leaves noiselessly through seven small vents in the radiator side of the outer shell. It is said that by substituting seven ports for the usual single port, all noise is eliminated. A large float chamber is included to provide plenty of space for air and water separation and to stop float bobbing and spitting. The manufacturer states that the syphon pipe will fit into the narrowest radiator and that any venting rate up to the capacity of a valve is obtained by merely turning the indicating screw on the top. Body is finished in satin aluminum with ribs polished.
SIZES AND CAPACITIES—⅛ in. angle pattern, ⅛ or ¼ in. straight pattern, ¾ in. male straight pattern with ⅜ in. female tapping in connection.
MADE BY—*Jas. P. Marsh Corp., Chicago, Ill.* *10*

Trane Gas Air Conditioner

NAME—Trane gas air conditioner.
PURPOSE—Gas-fired unit for winter or year-round air conditioning.
FEATURES—Gas-fired air conditioner serves the winter season with heating, humidifying, filtering and ventilating. An adjustable cascade humidifier and glass wool filters are provided. The unit is so constructed that a cooling section for summer air conditioning may be added later. This cooling section is made up of a Trane coil, plus the necessary connections. The air conditioning unit is self-contained and factory-assembled and all mechanical parts, including controls, are completely enclosed in a cabinet. Casing is fabricated of high-grade furniture steel finished in tapestry brown crinkle enamel. Unit is available for either floor or ceiling mounting. Connections required consist of gas and water pipes and electric connection. It is automatically controlled and once the pilot has been lighted the thermostat automatically takes care of the operation during the rest of the winter. Other controls provided include a safety control which is a combination gas pressure regulator, automatic main valve, safety pilot control, high temperature cut-off and reset mechanism; a sail switch which automatically shuts off the gas supply on the obstruction of the air outlet of the unit to prevent overheating; and a special summer-winter switch.
LITERATURE AVAILABLE—Bulletin No. S-320-1.
SIZES AND CAPACITIES—Available in either floor or suspended types, three models of each, capacities from 90,000 to 180,000 B.t.u. input.
MADE BY—*The Trane Co., La Crosse, Wis.* *11*

Fitzgibbons Winter Air Conditioner

NAME AND MODEL NUMBER—Fitzgibbons Special 80 Directaire.
PURPOSE—A direct-fired air conditioner designed for oil, gas, or stoker firing to provide cleaned, warmed and humidified air.
FEATURES—Unit consists of a steel furnace, a double inlet squirrel cage fan, throw-away filters, humidifying device and a jacket. Steel furnace is constructed of heavy copper boiler plate steel plates and tubes with all joints and seams exposed to the air stream welded. Units are shipped assembled with the inner casing, humidifying equipment and fan control in place. If desired, the unit may be adapted for summer cooling by the addition of a compressor and cooling coils. May be furnished with a jacket enclosing the automatic firing equipment or a standard jacket.
SIZES AND CAPACITIES—Two sizes,



capacities of 80,000 and 100,000 B.t.u. per hr. at the bonnet.
MADE BY—*Fitzgibbons Boiler Co., Inc., New York.* *12*

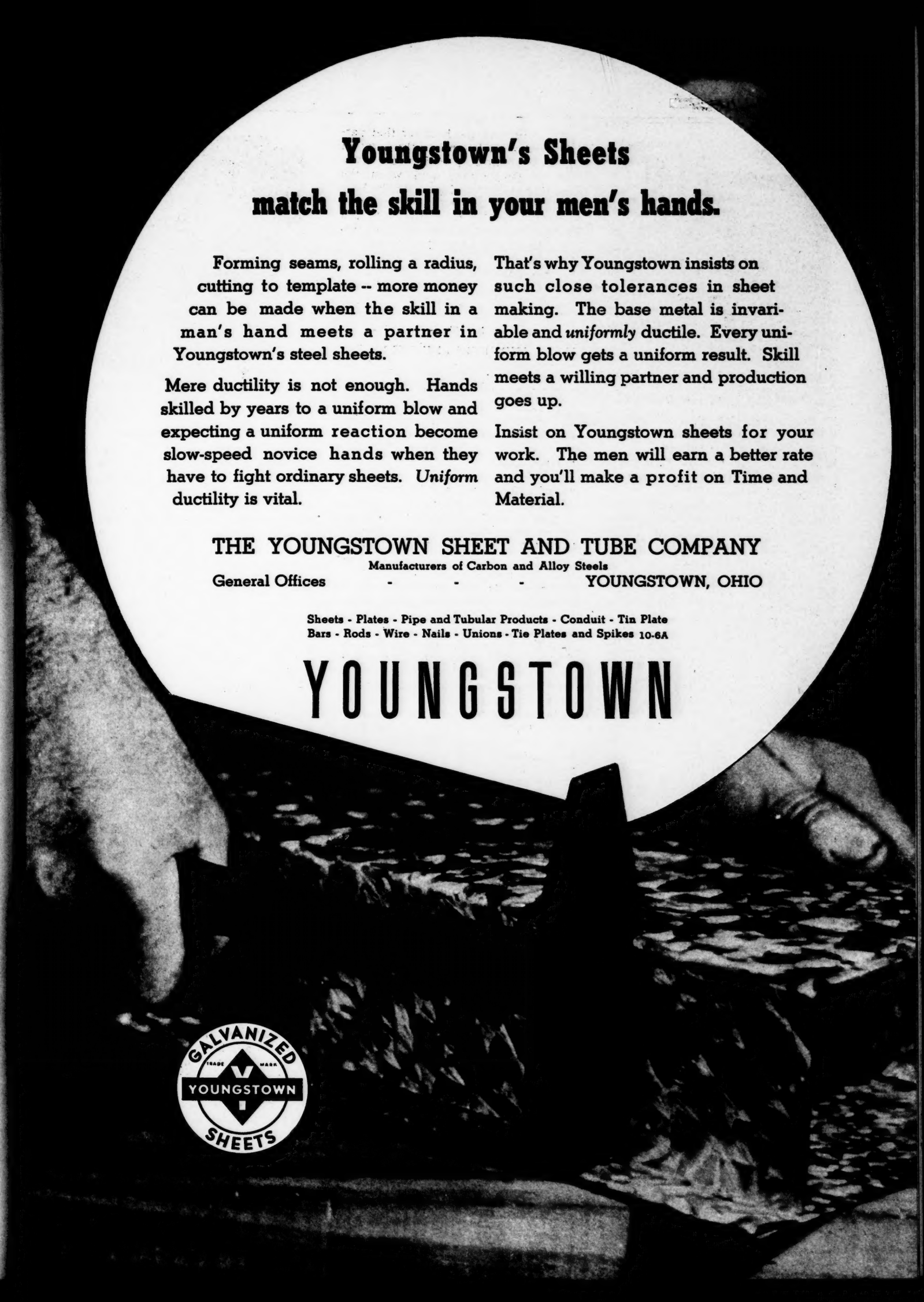
Oster Pipe Vise Stands

NAME—Oster power pipe vise stand.
PURPOSE—For thread cutting and reaming all sizes of pipe up to 2 in. inclusive, by power.
FEATURES—The pipe is gripped in a universal, bar-operated, scroll type chuck and is revolved by the power unit concealed in the upper part of the stand on which the pipe vise is usually mounted. The die-stock, cutter or reamer is placed on the pipe in the conventional manner with the handles resting on sliding arms which are built in the sides of the stand. When the power is turned on, the sliding arms take the torque of the pipe tools as the threading, cutting-off and reaming operations are performed. Power is furnished by a universal, variable-speed motor, geared to the spindle holding the chuck, giving the chuck variable speeds from 14 to 32 r.p.m. according to the load of the cut. The motor can be connected to an ordinary 110 volt lighting circuit. The height of the stand is 40 in.; width, 20 in., and length overall, including carrying handles, 30 in.
MADE BY—*The Oster Manufacturing Co., 2057 East 61st Place, Cleveland, Ohio.* *13*

Wayne Coal Stokers

NAME AND MODEL NUMBER—Wayne home heating stoker, Nos. W-25 and W-35.
PURPOSE—For automatic firing of coal.
FEATURES—The tuyeres are cast in small segments, located around a rectangular retort and are said to provide an extremely short air travel. The manufacturer states that power is greatly reduced by this feature. Feed worm is made of nickel chrome steel.
SIZES AND CAPACITIES—Made in two sizes with coal handling capacities of 25 and 35 lb. per hr.
MADE BY—*Wayne Oil Burner Corp., Fort Wayne, Ind.* *14*

(Continued on page 76)



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Insist on Youngstown sheets for your work. The men will earn a better rate and you'll make a profit on Time and Material.

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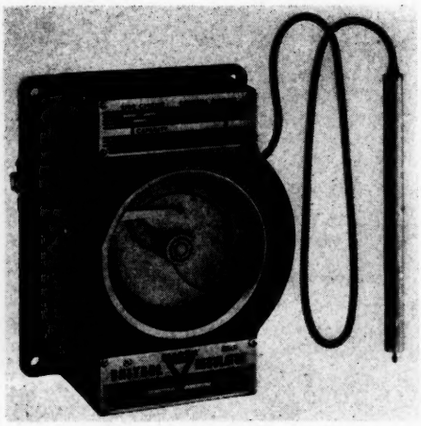
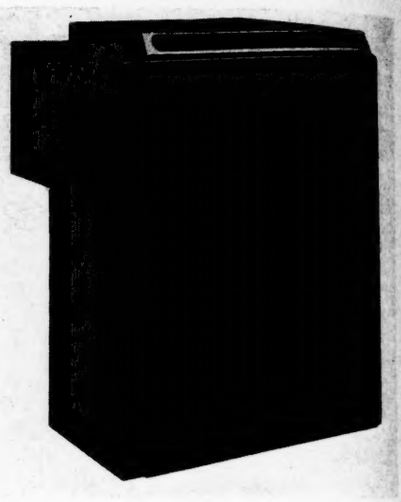


Marsh Heat Control

NAME—Marsh Unitrol.
PURPOSE—A heat regulating system for intermediate size buildings.
FEATURES—An outside control system which automatically controls the inside temperature according to outside weather conditions. System has been patterned after and incorporates all of the basic principles of the Marsh Tritrol which is used in large industrial plants and buildings. It differs in that it can be installed by the heating contractor, stoker or oil burner dealer. Its design permits accurate adjustment to characteristics of individual heating plants and heating programs desired. The system consists of an outside temperature-responsive bulb and the Unitrol. The outside bulb measures outside conditions and transmits this message by means of a capillary tube to the Unitrol. The Unitrol then determines the time of operation required to satisfy the outside temperature conditions and permits the firing device to operate during this time. On steam systems an aquastat is used for preventing the boiler water temperature from falling too low in mild weather. During the morning the control automatically determines the right time to turn on the heat for that particular day. It determines the duration of the warming-up period for the given outside temperature, and when the building is comfortably warm the heat is turned on and off periodically to meet the outside conditions. As the outside temperature falls, the on periods become longer, and as the outside temperature increases, the on periods become shorter.
MADE BY—*Marsh Tritrol Co., Chicago, Ill.* *15*

Wagner High Torque Motors

NAME AND MODEL NUMBER—High torque double-capacitor motor, types RZN and RZNR.
PURPOSE—For application on humidifiers, stokers, refrigerant compressors, and other applications where high starting torque, constant speed, quiet operation, and long-hour performance are required.
FEATURES—Motor has two condensers of different value, a high value of capacitance for starting and a low value of capacitance for running. The change in capacitance occurs at approximately 75% full load speed by means of a centrifugal switch located on the motor. In appearance and construction, the motor is similar to the other Wagner capacitor and split-phase motors of the same size. The capacitor box mounted on top is slightly larger than those used on capacitor-start induction-run motors since it contains two condensers instead of one. However, the size has been reduced because it does not contain an auto-transformer. Motors are available in two types, type RZN when equipped with rigid mountings and type RZNR when equipped with annular resilient mountings.
SIZES AND CAPACITIES—Four sizes with capacities of 1/3, 1/2, 3/4, and 1 hp. Available in 110 and 220 volts.
MADE BY—*Wagner Electric Corp., St. Louis, Mo.* *16*



Kauffman Room Cooler

NAME AND MODEL NUMBER—Portable room cooler, types A, W, and Y.
PURPOSE—For cooling, dehumidifying, cleaning and circulating air.
FEATURES—All of these units are of the portable type and are designed to be installed either in a window or next to it. The type A is for floor installation while types W and Y are for window installation. It is said that the type A unit will comfortably cool 4000 cu. ft. of space, with average glass or window openings, lighting and two occupants. The type W unit is said to be capable of cooling 2500 cu. ft. with ordinary exposures, while the type Y is designed to cool 1500 cu. ft. The latter two types will plug into any light socket.
SIZES AND CAPACITIES—Type A cooling capacity, 10,000 B.t.u. per hr.; air delivery, 350 c f.m.; power required, 1 hp. Type W cooling capacity, 6000 B.t.u. per hr.; air delivery, 275 c.f.m.; power required, ½ hp. Type Y cooling capacity, 4000 B.t.u. per hr.; air delivery, 200 c.f.m.; power required, 1/3 hp.
MADE BY—*Kauffman Air Conditioning Corp., St. Louis, Mo.* *17*

Rockwood Pipe Joint Compound

NAME—Rockwood pipe joint compound.
PURPOSE—For sealing pipe joints and gaskets on air, oil, hot and cold water, and steam lines.
FEATURES—This compound is said to lubricate threads while the pipe joint is being made up. The material is so compounded that the surface hardens into a protective skin which is said to eliminate oil drops when the compound is properly applied. The compound beneath the outer skin is not hardened, thus permitting the joint to be broken after years of service. The manufacturer states that the compound will not taint or discolor drinking water.
MADE BY—*Rockwood Sprinkler Co., Worcester, Mass.* *18*

TO OBTAIN FURTHER INFORMATION ON NEW EQUIPMENT

On the list below circle the item number of the equipment in which you are interested, using the identifying number found at the end of each description

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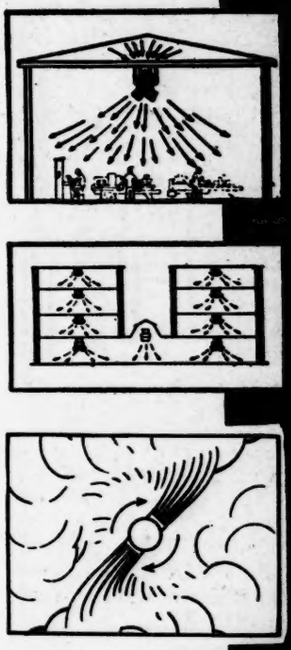
Has for Years Been Led by

Wing *Featherweight* UNIT HEATERS *Floodlights of Heat*

Through constant improvement of methods of creating air turbulence and heat distribution.



1. Circulating air from the upper space, thus preventing accumulation of heat overhead.

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3. Eliminating hot and cold spots and reducing heating costs.

Specified by the Leading Architects. Used by the Largest Industries.

A Recognized and Highly Endorsed Pioneer Product.

Use the Original and Obtain all the Exclusive Features.

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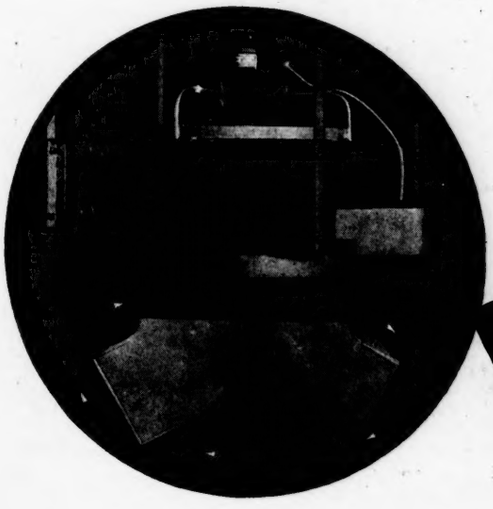
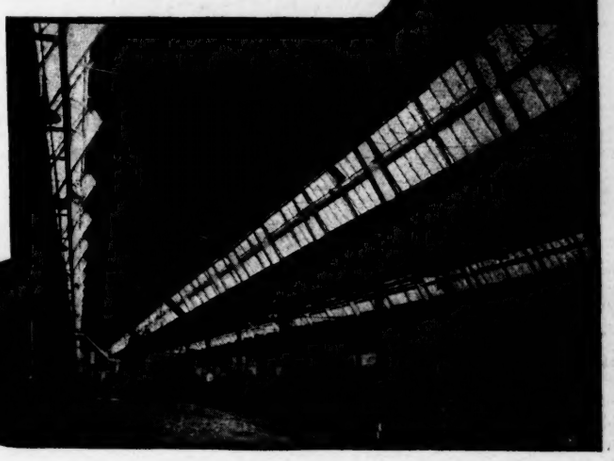
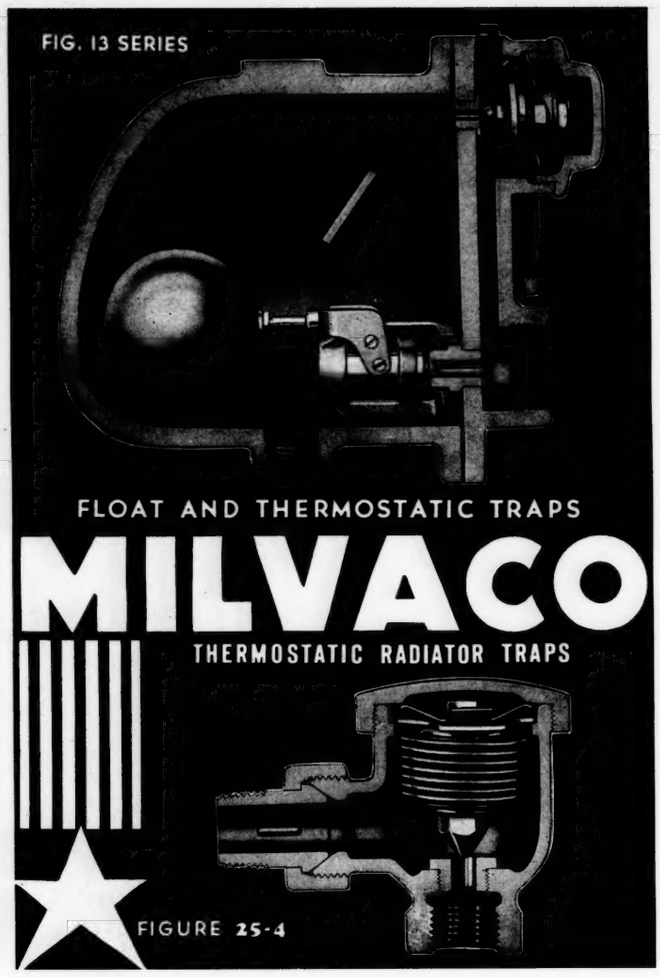
158 W. 14th St., New York, N. Y.



The latest addition is the Automatic Revolving Discharge, which produces the best results achieved to date in air turbulence and distribution, proven so necessary for even, comfortable heating.





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Manufacturers of
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NEW TRADE LITERATURE

Fan Blades. A standard-size, 12-page bulletin describing the advantages and features of the Torrington Airistocrat standard, deluxe and air circulator fan blades. Specifications and available sizes of each model are shown in table form while graphs give NEMA code recordings on air delivery and power consumption. Brief descriptions of other Torrington air impellers are included on the back cover. TORRINGTON MFG. CO., TORRINGTON, CONN. 1

Gas Boilers. A 24-page specifications catalog covering the line of National gas boilers for use with steam, vapor and hot water heating systems. Ten pages of the catalog are devoted to data applying to boilers when used exclusively for furnishing domestic hot water. Information is also given in regard to estimating hot water requirements, gas consumption and the selection of storage tank sizes for installation in apartment buildings, restaurants, laundries, and various other types of business establishments. Information as to piping connections and other helpful data are included for both direct and indirect hot water storage tank systems. NATIONAL RADIATOR CORP., JOHNSTOWN, PA. 2

Hay Fever. A pocket-size publication entitled "Relief from Hay Fever and Kindred Maladies by Means of Frigidaire Air Conditioning" outlining the results of a series of tests in which air conditioning equipment was used to retard and relieve suffering from hay fever and pollen asthma. The work was conducted by medical authorities on the research staff of a well known medical hospital. Of particular interest was the effect on sufferers of hay fever whose symptoms subsided quickly in the air conditioned atmosphere and in many cases relief continued for some time afterwards. DELCO-FRIGIDAIRE CONDITIONING DIV., GENERAL MOTORS SALES CORP., DAYTON, OHIO. 3

Heat Economizers. A revised edition of the ADSCO bulletin No. 35-76 on ADSCO heat economizers. The section which was revised illustrates two of the many heat economizer applications and contains two charts, one whereby the amount of economizer heating surface can be determined and another indicating the final temperature of the domestic water after passing through the economizer, based on varying condensate inlet temperatures. AMERICAN DISTRICT STEAM CO., NORTH TONAWANDA, N. Y. 4

Hot Water Heating Systems. A standard-size, four-page bulletin, No. EC-638, describing the new Thrush heat control devices and Thrush flow control warm water heating system. Heat control devices described include the following controls: radiant heat, modulating boiler, water temperature, immersion type water temperature, and clamp-on type water temperature. H. A. THRUSH & CO., PERU, IND. 5

Refractories. A small-size pamphlet, Form RC-12A, describing refractory products for stoker installations. These materials include castable refractories for building hearths and lining doors of domestic and industrial stokers, a refractory cement for bonding fire brick and for wash coating, and asbestos furnace cement for sealing joints against gas leakage and air infiltration. JOHNS-MANVILLE, 22 E. 40TH ST., NEW YORK. 6

Stainless Steel. A standard-size, 16-page booklet giving interesting and valuable data on heat-resisting grades of stainless steel. Typical analysis, average physical properties, service at elevated temperatures, and recommendations for handling these specialty grades of Armco stainless steels are presented in the booklet. Two of the grades discussed will resist destructive heat scaling at temperatures as high as 2000F. THE AMERICAN ROLLING MILL CO., MIDDLETOWN, OHIO. 7

Steam Jet Refrigeration. A standard-size, six-page leaflet, F.8445, on vacuum cooling. Apparatus is for either continuous or batch cooling within a range of 35 to 65F. WESTINGHOUSE ELECTRIC & MFG. CO., EAST PITTSBURGH, PA. 8

Steam Plant Equipment. A standard-size, 12-page bulletin, G-1304, which is a condensed catalog on the Yarway line of steam plant equipment. Includes information on the following valves: blow-off, seatless, double-tightening, tandem, and unit-tandem, as well as on water columns, water level gages, expansion joints, spray nozzles and steam traps. YARNALL-WARING CO., PHILADELPHIA, PA. 9

Steel Boilers. A standard-size, 24-page general catalog, No. 80-e, covering the full line of Kewanee steel boilers. The purpose is to give in compact form the specifications and methods on all sizes of Kewanee boilers. Includes information on all boilers from the Type R residential up to the 400 Series portable updraft boiler with a capacity of 42,500 sq. ft. of radiator surface. Also gives information on water heaters, garbage burners and tanks. KEWANEE BOILER CORP., KEWANEE, ILL. 10

Unit Coolers. A standard-size, 40-page bulletin, No. 105, on 336 cooling units made by the Rempe Company for low temperature and comfort cooling. Bulletin contains engineering data and information on selecting the correct unit, includes sample problems and solutions, tables covering air velocities, B.t.u. requirements for content cooling or product load, heat leakage and performance ratings. The matter of making a selection of a unit has been simplified and places selection on the basis of high efficiency. REMPE CO., CHICAGO, ILL.....11

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Double-Barreled Testimony

PARKS & HULL
APPLIANCE CORPORATION

1035 CATHEDRAL STREET - Phone, VERNON 6060
BALTIMORE, MARYLAND
June 2, 1938

Automatic Products Company
2450 N. Thirty-second Street
Milwaukee, Wisconsin

Attention: Mr. E. A. Vallee

Gentlemen:

For over two years we have been handling your Automatic Products Thermal Expansion Valves for resale to the refrigeration trade in the Baltimore area, and we are more than glad to state at this time how satisfactory this product has been.

Of the many valves that we have sold, our returns due to defective valves have been practically negligible. It is a product that we can recommend with the greatest of sincerity and a product which our customers have used with the greatest of satisfaction. As one of our customers has expressed it, "If you have trouble, put an Automatic Products valve on and forget it."

To our customers we recommend the trial of an Automatic Products valve, and are sure that after the trial they will want no other.

To you as our supplier we extend our appreciation of a very splendid product.

With best wishes for your continued success and our mutual profit, we are,

Very truly yours,
PARKS & HULL APPLIANCE CORPORATION
George J. Roche
President

GJR:F

DEPENDABLE
The Byword for A-P Valves

- *Installation* — Scherr's Food Market, Baltimore, Md.
- *Cabinets* — Fleetwood
- *Refrigeration Unit* — Brunner Mfg. Co.
- *Installed by* — Frame, Isaacs & Rodbell, Baltimore, Md.

Phone. Vernon 6787

FRAME, ISAACS & RODBELL
DISTRIBUTORS OF
..FLEETWOOD..
Complete Food Market Equipment, Commercial Refrigeration
609 NORTH EUTAW STREET
Baltimore, Md.
May 20, 1938

Mr. Roche,
c/o Parks & Hull,
1035 Cathedral St.,
Baltimore, Md.

Dear Sir:-

It is indeed a pleasure to inform you that after having used various other makes of expansion valves, we are now using A.P. valves exclusively.

Since using these A.P. valves, I can say without exaggeration that our service trouble have been reduced by more than half. Our business is built on the good will of our customers, and there is no greater enemy of good will than a constant need for service.

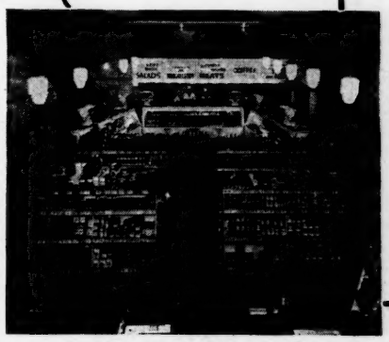
Enclosed is a picture of one of our recent installations which we refrigerated with Brunner Compressor and A.P. valves.

Very truly yours,
FRAME, ISAACS & RODBELL,
J. Frame.

JF:G

VALVES

- *Purchased through* Parks & Hull Appliance Corp. Baltimore, Md.



When Installing Engineers, Service Engineers, and Refrigeration Jobbers all vouch for A-P Valve efficiency, that's Reputation well-earned. But when Valve USERS add "If you have trouble, put on an A-P Valve and forget it" — here is more proof than any "doubting Thomas" would dare quibble about.

The enthusiastic testimony of the refrigeration industry's leaders surely is sufficient evidence that A-P Valves really have something. If you have not already proved this in your own experience, we'll welcome the opportunity to give you more information.

AUTOMATIC PRODUCTS COMPANY
2462 NORTH THIRTY — SECOND STREET
MILWAUKEE WISCONSIN

- *Refrigeration Parts Jobbers, Who Recognize Quality, Stock Controls*

DEPENDABLE

WITH THE MANUFACTURERS

Air-Maze Corp., Cleveland, Ohio, has appointed *H. B. Cleveland*, San Francisco, as its factory representative for San Francisco and northern California. Mr. Cleveland will handle the company's complete line of air filters for industrial and air conditioning applications.

The American Rolling Mill Co., Middletown, Ohio, has established a district sales office in Minneapolis. *W. A. Danner* is district manager, assisted by *S. A. Yager*.

Anthracite Industries Inc., 3207 Chrysler Building, New York, re-elected *Frank W. Earnest, Jr.*, president at the annual board of directors meeting. Other officers re-elected were *G. Gordon Cook*, vice-president and treasurer, and *George W. Barnes*, secretary.

Buffalo Forge Co., Buffalo, N. Y., announces that *Arthur A. Day*, fan shop superintendent, for 46 years with the company, retired June 27. In 1888 he started as a helper in the Monroe Furnace Company and after two years went with the M. F. Talmage Sheet Metal Works. His next employer was the Berkhausen Sheet Metal Shop where he worked eighteen months before going to Buffalo Forge. There his first job was as a sheet metal worker, then as a layout man in the sheet metal department, and finally as general foreman and superintendent of the fan shop and all sheet metal working departments. Mr. Day's son Leonard has been named to succeed his father as fan shop superintendent.

Illinois Iron & Bolt Co., Free-Man Stoker Div., 918 S. Michigan Ave., Chicago, has appointed *George B. Riddle* sales promotion manager. He will have charge of all advertising and sales promotion activities. Mr. Riddle was formerly associated with the Frigidaire Div. of General Motors where he was engaged in sales planning and dealer merchandising work.

George B. Riddle

H. A. Thrush & Co., Peru, Ind., has transferred *Harry E. Thompson* from its general sales department to the Philadelphia office as a factory sales representative covering the Philadelphia metropolitan area. *Henry D. Johnson*, Milwaukee, Wis., will represent the company as direct sales representative in the greater Wisconsin territory.

Torrington Manufacturing Co., Torrington, Conn., has been honored through having one of its advertisements, featuring spring making machinery, included in the Milline Collection of the Best Advertisements of 1938. The advertisement was handled by The Stentor Co., Hartford, Conn.

Westinghouse Electric & Mfg Co., has reorganized its air conditioning department with headquarters located at the company's East Springfield, Mass., plant. *P. Y. Danley* has been named manager of the department and *S. F. Myers* assistant manager. Mr. Myers will be located in Chicago. *H. F. Hildreth* will direct the sale of home air conditioning equipment. The Air Conditioning Department will function as a separate organization and will not be directly associated with the present merchandising division.

STOPS FIRE *as well as* NOISE

JOHNS-MANVILLE JM PRODUCTS **Johns-Manville**

AIRACOUSTIC SHEETS FOR DUCT LINING

DANGER of fire starting and spreading in duct linings is too serious a question to overlook.* Particularly when it can be avoided with a lining material that combines unusually high sound-absorption qualities with complete fire-safety.

J-M Airacoustic Sheets do exactly that. Entirely mineral in composition, they provide as high as 70% sound-absorption. And they *cannot burn or smolder* . . . will not contribute to the spread of fire.

Moreover, J-M Airacoustic Sheets are light in weight . . . easily handled and easily applied. Their transverse strength is high, thermal conductivity low. And, because Airacoustic Sheets are highly resistant to moisture, they are exceptionally free from the dangers of humidity.

Get all the facts. They'll show you how you can use J-M Airacoustic Sheets on all your duct-lining jobs to both your clients' and your own advantage. For full details, write Johns-Manville, 22 East 40th St., New York, N. Y.

*A recent bulletin from the National Board of Fire Underwriters reports several cases of this very nature.

Weatherall Engineers, Inc., is the new corporate name of Braden Engineering, Inc., Providence, R. I. *R. H. Chadwell* has been appointed vice-president and general manager; *J. E. Vaughan* has been named western sales manager with headquarters in Chicago; *Russell M. MacDonald* is the New England sales manager.

Worthington Pump and Machinery Corp., Harrison, N. J., has appointed *Ludwig Emde* Detroit district sales manager. A member of the Worthington organization since his graduation from the University of Michigan in 1930, Mr. Emde succeeds William J. Daly, recently named manager of the Philadelphia office.

COMING EVENTS

SEPTEMBER 21-23, 1938. 16th Annual Conference, National Industrial Advertisers Association, Cleveland, Ohio. Stanley Knisely, Advertising Manager, Republic Steel Corp., Cleveland, Ohio.

OCTOBER 10-13, 1938. American Gas Association Convention, Municipal Auditorium, Atlantic City, N. J.

DECEMBER 5-10, 1938. 13th National Exposition of Power and Mechanical Engineering, Grand Central Palace, New York.

DECEMBER 6-8, 1938. Annual Meeting, American Society of Refrigerating Engineers, Hotel Commodore, New York.

JANUARY 23-27, 1939—Annual Meeting, American Society of Heating and Ventilating Engineers, Pittsburgh, Pa.

MAY 22-24, 1939. Spring Meeting, American Society of Refrigerating Engineers, Hotel Hershey, Hershey, Pa.

SUMMER DEGREE-HOURS (ABOVE 85F)* JULY, 1938

City	July, 1938	July, 1937	Year, 1938 to July 31	Year, 1937 to July 31
Baltimore	513	693	739	951
Birmingham	586	778	928	2036
Bismarck	252	463	364	712
Boston	66	274	147	373
Buffalo	2	9	4	16
Chicago	112	182	127	355
Cincinnati	292	353	360	580
Cleveland	42	50	50	57
Columbus	372	334	493	434
Des Moines	988	795	1221	1222
Detroit	95	231	146	267
Fort Wayne	90	277	120	315
Grand Rapids	65	429	107	518
Houston	985	1181	1573	2280
Indianapolis	241	298	267	424
Kansas City	1927	1505	2203	2444
Memphis	1077	367	1244	1123
Milwaukee	48	231	49	323
Minneapolis	127	763	238	896
New Orleans	710	826	1425	1646
New York	33	315	41	345
Philadelphia	197	505	282	593
Pittsburgh	163	189	169	256
Portland, Oreg.	447	28	526	111
Richmond, Va.	259	594	364	959
St. Louis	1052	567	1214	1135
San Diego	0	0	0	0
San Francisco	0	0	0	1
Savannah	347	673	1192	1606
Toledo	111	288	169	326
Washington	466	508	689	719

*Based on data made available through the cooperation of the U. S. Weather Bureau.

IF YOU WILL
REMEMBER
TO USE
MERCOID
Controls for all unit heater applications, - you can forget them after they are installed.
• They are built to give many years of trouble-free service.
• Being dust and grime proof, they are specially suitable for various conditions encountered in different industrial fields.
•The well-known Mercoid switch, used in all Mercoid Controls, is immune to corrosive action.
•Apart from the sturdiness of Mercoid Controls, they are very sensitive, thus assuring even all-around temperature control.
•They do not cost any more and will save much money in the end.

THE MERCOID CORPORATION